Eskom	Technical Specification	Technology

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1. INTRODUCTION

This document provides the technical specifications for the replacement of units 1 through 6 main turbine and BFPT oil purifier skids. The current main turbine and BFPT oil purifier skids were declared obsolete by the Original Equipment Manufacturer (OEM) in 1990 and 1992 respectively. The OEM can no longer supply spares and technical support for these oil purifiers. This is why they need to be replaced. The requirements provided in support of the replacement of the oil purifiers include electrical, C&I, etc. specifications.

2. SUPPORTING CLAUSES

2.1 SCOPE

This document covers the applicable work to be done, as well as the requirements and specifications regarding the work.

2.1.1 Purpose

The purpose of this document is to provide the *Contractor* with all the relevant details required to perform work as defined in the scope.

2.1.2 Applicability

This document shall apply to Lethabo Turbine Plant Engineering, Lethabo Electrical Engineering, Lethabo C&I Engineering, Technology Engineering, Lethabo Projects Department, Lethabo Drawing Office and all other stakeholders involved in planning and execution of the Lethabo Units 1-6 main turbine and BFPT oil purifier replacement project.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] 375-LET-MDDD-D00185-7: Lethabo Power Station Main Turbine and BFPT Oil Purifier Replacement Root Cause Analysis Report.

[2] 375-LET-MDDD-D00186-2 Lethabo Power Station Main Turbine and BFPT Oil Purifier Replacement Required Operational Capability Report.

[3] 375-LET-AABB-D00139-88 Lethabo Power Station Replacement of main turbine and BFPT oil purifiers Units 1-6 – Stakeholder Requirements Definition Report

[4] 375-LET-AABB-D00139-91 Lethabo Power Station Replacement of Main Turbine and BFPT Oil Purifiers SRD EOP

[5] 375-LET-AABB-D00139-81 Lethabo Power Station Main Turbine and BFPT Oil Purifier Replacement Concept Design Report

[6] 375-LET-AABB-D00139-93 Lethabo Power Station Main Turbine and BFPT Oil Purifier Replacement Project Concept Design End-of-Phase Design Review Report

[7] 375-LET-ADDB-D00180-1 Lethabo Power Station Main Turbine and BFPT Oil Purifier Replacement Basic Design Report

[8] 375-LET-AABB-D00139-95 Lethabo PS Main Turbine and BFPT Oil Purifier Replacement Basic Design EOP

[9] 240-53113685: Design Review Procedure

[10] 240-53665024: Engineering Quality Manual

[11] PER – Pressure Equipment Regulation 2009.

[12] 375-LET-AABB-D00139-86 – Lethabo Power Station Replacement of main turbine and BFPT oil purifiers Units 1-6 – EMAP Report

[13] 0.63/70097 Turbine Lube Oil System

[14] 0.63/70098 BFPT Lube Oil System

[15] Lethabo Power Station MAN Instruction Manual Volume 27 Oil Purifier – Main Turbine

[16] Lethabo Power Station MAN Instruction Manual Volume 28 Oil Purifier – BFPT

[17] 0.63/3208 Oil Room Layout

[18] 0.63/17349 Drainage and Oil Recovery System

[19] 240-56227443 Requirements for Control and Power Cables for Power stations Standard

[20] 240-56355815 Control & Instrumentation Field Enclosure and Cable termination Standard.

[21] 240-56355754 Field Equipment Installation Standard.

[22] LBT00081 – Drawing Office Procedure.

2.2.2 Informative

[23] ISO 9001:2015 Quality Management System.

[24] LBT00055 SG – Lethabo Power Station Turbine centreline maintenance strategy.

[25] LBT00057 SG – Lethabo Power Station BFPT maintenance strategy.

[26] 240-109607332 – Eskom Plant Labelling abbreviation standard.

[27] LIM103 – Lethabo Information Manual.

[28] 36-681 General Plant Safety Regulations

[29] LBS00067 Lethabo Health, Safety and Environmental Specification for Contractors

2.3 DEFINITIONS

Description	Definition
Centrifuge	A device that uses centrifugal force to separate oil and water.
Lube oil	Oil used to lubricate and cool the turbine and BFPT bearings.
Stakeholder	Is considered to be anyone that has an interest in the outcome of the project.
Turbine Plant	A collection of the turbine centreline and auxiliaries plants.

2.4 DISCLOSURE CLASSIFICATION

Controlled Disclosure: Controlled Disclosure to external parties (either enforced by law, or discretionary).

2.5 ABBREVIATIONS

Abbreviation & Acronyms	Description
AKZ	Anlagen-Kennzeichnungs System
BFPT	Boiler Feed Pump Turbine
CoE	Centre of Excellence
C&I	Control and Instrumentation
CM	Configuration Management
DCS	Distributed Control System
ECM	Engineering Change Management
ECR	Engineering Change Request
EDMS	Electronic Document Management System
EDWL	Engineering Design Work Lead
EE	Electrical Engineering
EMAP	Engineering Management Plan
EMS	Electrical Maintenance Services
ERA	Execution Release Approval
FAT	Factory Acceptance Test
GO	General Overhaul
HMI	Human Machine Interface
HP	High Pressure
IR	Interim Repairs
ISO	International Organization for Standardization
kW	Kilowatt
LCP	Local Control Panel
LDE	Lead Design Engineer
MMS	Mechanical Maintenance Services
MSDS	Material Safety Data Sheet
NB	Nominal Bore
NCR	Non Conformance Report
NDE	Non Destructive Examination
OEM	Original Equipment Manufacturer
OES	Optical Emission Spectroscopy
PEI	Production Engineering Integration
PLC	Programmable Logic Controller
QCP	Quality Control Plan
RCA	Root Cause Analysis
ROC	Required Operational Capability
SANS	South African National Standard

Abbreviation & Acronyms	Description
SoW	Scope of Work
SRD	Stakeholder Requirements Definition
TPE	Turbine Plant Engineering
VDSS	Vendor Document Submittal Schedule

2.6 ROLES AND RESPONSIBILITIES

The following roles and responsibilities apply:

Person	Responsibility
Engineering	Clarification of scope if required. Quality inspections for technical adherence. Documentation review, final acceptance and sign-off
Employer	Issues the scope of work
Contractor	Execution of the specified scope of work.
Project Manager	Planning and execution of the project
Site QC	Quality inspections

3. BACKGROUND AND HIGH LEVEL SCOPE

3.1 PROJECT BACKGROUND

Lethabo Power Station has six units. The station has one main turbine oil purifier and one BFPT oil purifier per unit. The oil purifiers are used to remove water and particle contaminants from their respective lube oil systems. The station's water content specification is 200 ppm (maximum) and the cleanliness specification (particle contamination) is 15/12 (maximum) according to ISO 4406. They also heat up the oil and maintain it at a desired temperature. Lube oil is used to cool and lubricate the turbine and BFPT bearings. Both oil purifiers are centrifuges originally supplied by Alfa Laval (OEM). The main turbine oil purifier (MAB 209) was declared obsolete by the OEM in 1990 and the BFPT oil purifier (MAB 204) was declared obsolete in 1992. Spares are still available upon request but have long lead times. The OEM cannot guarantee spares availability or technical support for these oil purifier models.

For the above reasons an alternative oil purification technology, which is capable of maintaining the station's turbine lube oil specification needs to be considered. Figure 1 shows the main turbine lube oil system. The main turbine oil purifier takes suction from the bottom of the main oil tank and discharges the oil back to the tank. The current main turbine oil purifier has an operating flow rate of 13 700 l/hr, and it is operated locally.

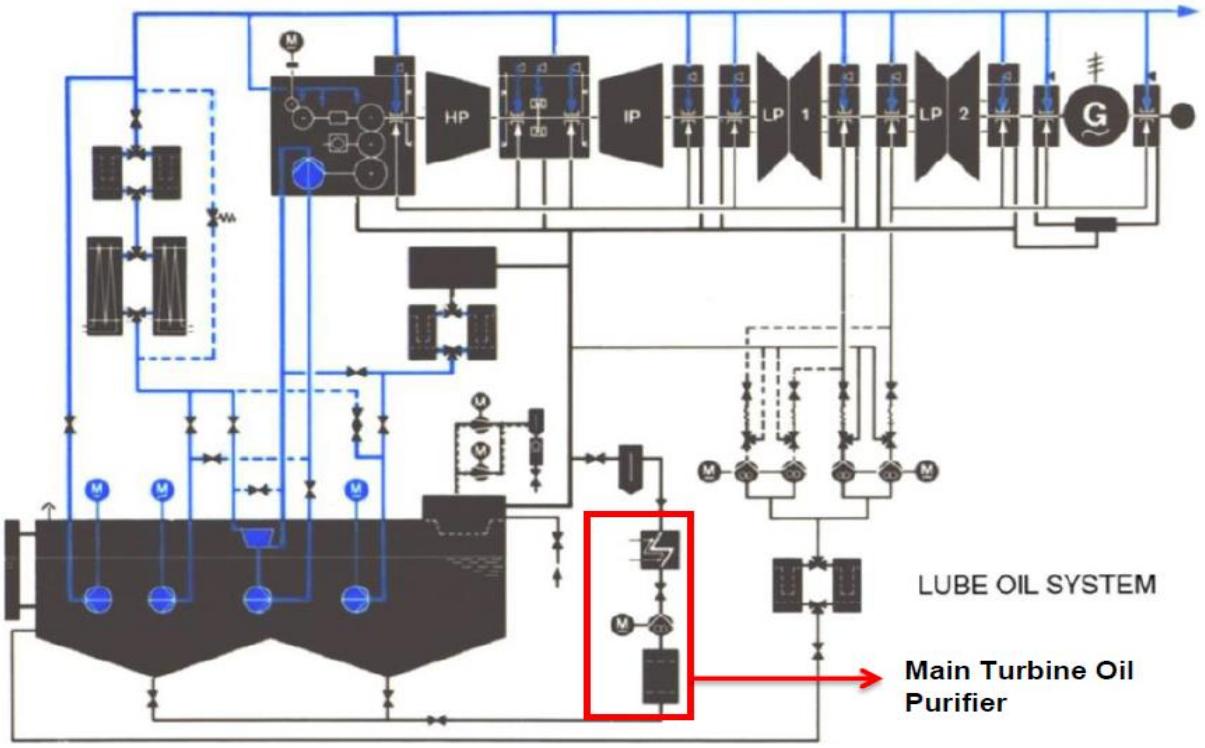


Figure 1: Main Turbine Lube Oil System

Figure 2 shows the BFPT lube oil system. The BFPT oil purifier takes suction from the bottom of the BFPT lube oil tank and discharges the oil back to the tank. The current BFPT oil purifier has an operating flow rate of 2 800 l/hr, and it is operated locally.

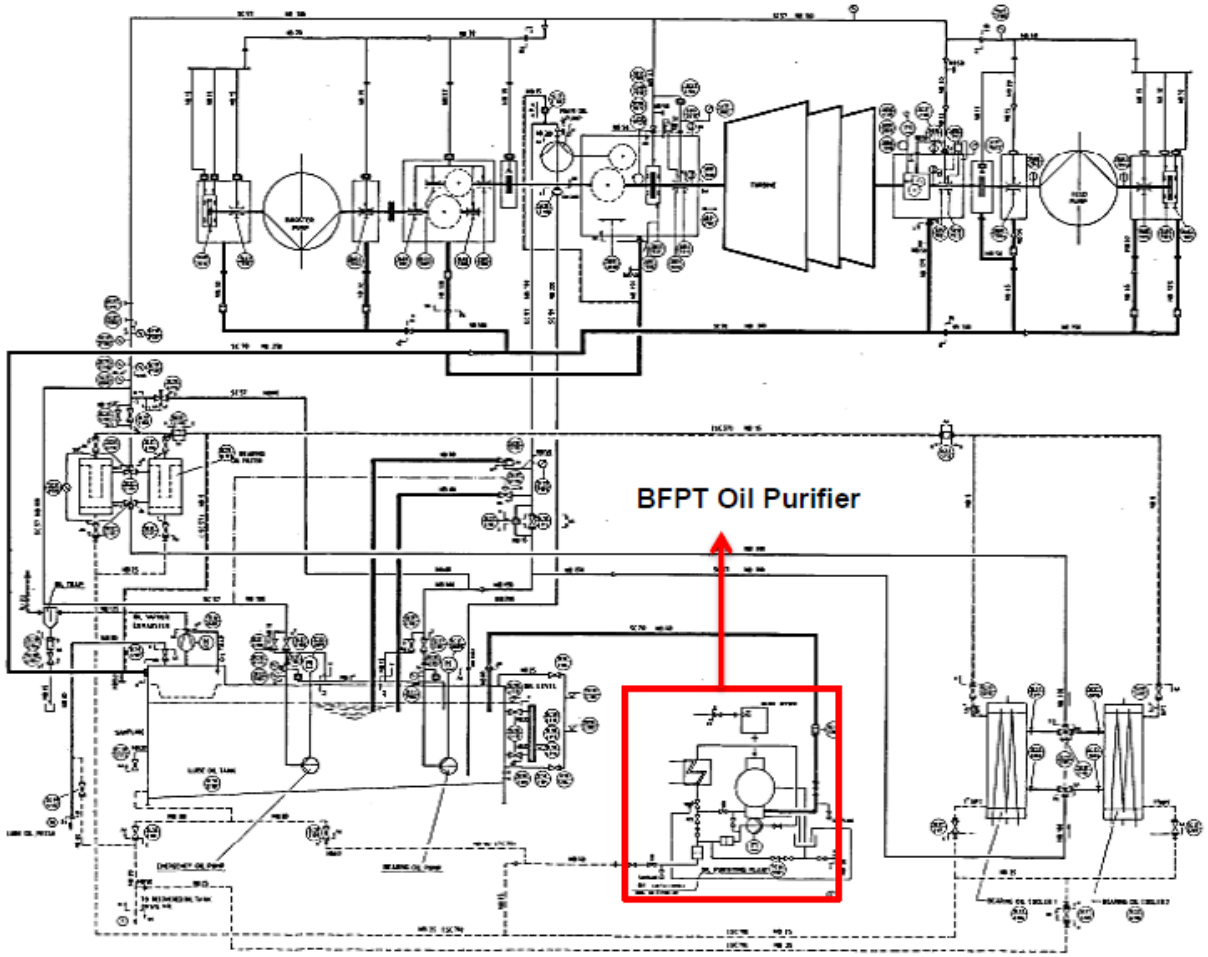


Figure 2: BFPT Lube Oil System

Centrifuges were selected as the replacement oil purification technology during the concept design phase.

3.2 PROJECT PURPOSE AND HIGH LEVEL SCOPE

The purpose of this project is to replace the current main turbine and BFPT oil purifiers with suitable centrifuges so as to improve the availability and reliability of the oil purification plant for both the main turbine and BFPT lube oil systems. The high level scope of this project, applicable to units 1 through 6, will include the following:

- The *Contractor* will be responsible for the detail design, manufacturing, supply, installation, quality assurance, commissioning and handover associated to this project as stated in the scope of work as per sections 4.8-4.11 of this document.
- Detail design to be accepted by the *Employer*.
- *Contractor* site establishment to commence once the detail design is accepted and the project is ready for execution.
- The *Employer* will decommission the current main turbine and BFPT oil purifiers. The *Contractor* will remove the current main turbine and BFPT oil purifier skids installed at the plant. The Contractor will transport the above mentioned to a location of the *Employer's* choosing.
- The *Contractor* will execute the detailed mechanical (Section 4.8), C&I (Section 4.9), Electrical (Section 4.10) and civil (Section 4.11) scope as stated in this document.

- The *Contractor* will be responsible alongside the *Employer's* representatives for commissioning of the new plant installations. The *Contractor* will conduct factory acceptance tests (FAT) of the new oil purifier skids before installation in the presence of the *Employer's* representatives.
- The *Contractor* will provide the *Employer* with all relevant documentation applicable to the new installations as stated in this document.
- The *Contractor* will provide training on the new installations to the *Employer's* maintenance, operating and engineering staff. Training will take place before installation and commissioning of the first oil purifier skids. The training shall include both theoretical and practical training. Training for operating staff will be focused on operating and troubleshooting of the oil purifier skid. Training for maintenance and engineering staff will be focused on operating, troubleshooting and maintenance of the oil purifier skid. Training for MMS turbine and TPE personnel must focus on operating, mechanical troubleshooting and maintenance of the oil purifiers. Training for EMS and EE personnel must focus on operating, electrical troubleshooting and maintenance of the oil purifiers. Training for C&I maintenance and engineering personnel must focus on operating, C&I troubleshooting and maintenance of the oil purifiers. Operating and maintenance trainees must receive certificates upon successful completion of the training. Training will be done on site and the Contractor will provide the training material. The minimum number of people that will require training from each department is as follows:
    - Operating – 21
    - Maintenance – 50 (MMS Turbine 10, EMS 20 and C&I Maintenance 20)
    - Engineering – 7 (TPE 2, EE 2 and C&I Engineering 3)

3.3 CODES AND STANDARDS

The *Contractor* shall adhere to the following codes and standards:

C&I

- 240-56227443 Requirements for Control and Power Cables for Power stations Standard.
- 240-56355815 Control & Instrumentation Field Enclosure and Cable termination Standard.
- 240-56355466 Alarm Management System Guideline
- 240-56355888 Temperature Measurement Systems Installation Standard
- 240-56355843 Pressure Measurement Systems Installation Standard
- 240-56355789 Flow Measurement Systems Installation Standard

Electrical

- 240-56356396 Earthing and Lightning Protection.
- 240-56355754 Field Equipment Installation Standard.
- 240-57617975 New Low Voltage Motors Procurement Standard.

Mechanical

- 240-56063935 Turbine Oil Standard
- 240-89147446 Impulse Piping for Coal Fired Power Plants Standard
- 240–106628253 Welding Requirements on Eskom Plant Standard
- 240-83539994 Non-Destructive Testing (NDT) on Eskom Plant Standard

Civil

- 240-56364545 Structural Design and Engineering Standard

Drawings and Procedures

- 240-86973501 Engineering Drawing Standard – Common Requirements.
- 240-56030537 Review of Piping and Instrumentation Diagrams.
- 240-109607332 Eskom Plant Labelling Abbreviation Standard.
- 240-61227631 Piping and Instrumentation Diagram (P&ID) Standard.
- 36-943 Engineering Drawing office and Engineering Documentation Standard.
- 240-105658000 (QM 58) Supplier Quality Management Specification.

4. REQUIREMENTS

4.1 SAFETY REQUIREMENTS

- The *Contractor* shall comply with the latest revision of the Eskom Generation Plant Safety Regulations, site specific procedures and stipulations of the OHS Act [28].
- The *Contractor* shall provide authorized supervisors to oversee their work at all times. This will be explained in the contract Works information (Part C4).

4.2 GENERAL REQUIREMENTS

1. Provision, erecting, removal and replacement of scaffolding, lagging and cladding and all rigging requirements as required for the completion of the works will be provided by the *Contractor*.
2. All off-site NDE (during manufacturing) will be the responsibility of the *Contractor* and must comply with the requirements of section 4.4 NDE Requirements. The *Employer*'s representative will conduct inspections (as per agreed hold-points) at the *Contractors*' premises to ensure compliance if and when required.
3. Unless otherwise stated (for example, items that are to be relocated), the *Contractor* is responsible for the removal of all items and material that are redundant (items that are removed) as part of the works. These are removed from the plant area and are laid down on site at a location to be indicated by the *Employer*.
4. Where this document is not clear about the location of an item to be installed or work to be done, it is the *Contractor's* responsibility to determine the correct location from the *Employer's* engineering representatives, and the *Contractor* will only act upon confirmation by receipt of an Engineering Instruction via the *Employer's* Project Manager. Incorrectly positioned items, or incorrect work done (where Engineering Instructions were not issued) will be moved / removed / replaced / changed / reinstalled by the *Contractor* at his cost unless it can be explicitly proven that this document unambiguously shows an incorrect position/arrangement.
5. The *Contractor* will be responsible for all interfacing, functionality and compatibility of the oil purifiers, C&I and electrical installations.
6. All flanged connections loosened as part of the works shall be fitted with new gaskets (All gaskets to be supplied by the *Contractor*). Non-asbestos type gaskets to be used and MSDS for gaskets should also be provided. Bolts to be used must be torqued to 60% of the yield strength. All bolts to be torqued (not flogged) in the "star" sequence in increments as sound engineering practice dictates. All bolts and nuts to be lubricated. After final tightening of the bolt at least two threads will protrude behind the nut.

7. The Contractor shall provide the Employer's Project Manager with a method statement and project schedule. The project schedule shall align with the Employer's outage dates as replacement of the oil purifier skids will be done during outage opportunities (IR or GO).

4.3 MATERIAL REQUIREMENTS

1. The *Contractor* is responsible for supply of the main turbine and BFPT oil purifier skids, connection brackets (if any), any and all consumables required, C&I and electrical cabling, gaskets as well as bolts and nuts if required.
2. All material and equipment supplied by the Contractor shall be designed to operate in a high temperature, oily and dusty environment. The material and equipment must also be able to handle oil with the following specifications:
    - Operating Temperature: 50 – 70 ^{o}C
    - Viscosity: 46 cSt @ 40 ^{o}C
    - Pour Point: - 6 : ^{o}C
    - Flash Point: 190 ^{o}C
    - Water Concentration: 200 ppm

4.4 QUALITY REQUIREMENTS

1. No work will be done without a QCP that is approved by the *Employer*. A QCP must be submitted to the *Employer* for the works 14 days before that part of the work is to commence.
2. QCP's and related documentation shall be subject to comment and acceptance by the *Employer's* Quality Control personnel as well as Engineering. QCP's will make provision for signatures for interventions by at least the Contractor's QC Representative, the *Employer's* QC Representative and the *Employer's* Engineering Department.
3. Each QCP will have a page for proof signatures, so that any signature can be traced to the individual who has endorsed any activity on QCP.
4. Intervention points will be signed as the work progresses and no back-dating will be allowed.
5. Notification for hold and witness points shall be in writing and shall be done at least 24 hours in advance.
6. The following minimum hold points must be included for the *Employer's* Quality Control Department:
    - Approval of QCP.
    - Review material certificates and specifications for the main turbine and BFPT oil purifier skids.
    - Main turbine and BFPT oil purifier skid inspection once manufacturing is complete.
    - Review specifications for all C&I and electrical consumables purchased/to be used during installation.
    - Review and assist with the commissioning of the new installations.
    - Final Sign off and Acceptance.
    - Final data book Review.
7. The following points to be included as a minimum on the *Contractor's* QCP:

- Approval of QCP's by the Employer's Engineering representative, Employer's QC and the Contractor's representative.
- Intervention points for the *Employer* during manufacturing, installation and commissioning. These intervention points will be based on the agreement between the *Contractor* and *Employer*.
- Ensure that all permits are established before work can commence.
- Mark the equipment with the appropriate AKZs. Labelling should be done in accordance with the Lethabo Power Station Information Manual [27].
- Remove current main turbine and BFPT oil purifiers from the plant.
- Visual inspection of consumables, nuts and bolts, new oil purifier skids before installation into the plant.
- Mechanical, C&I and electrical commissioning and functionality testing by the Contractor and Employer's representatives.
- Final approval of QCP and plant handover to the *Employer's* engineering representative.

4.5 DRAWING REQUIREMENTS

1. The *Contractor* shall update all plant drawings, increasing the revision number by 1 for the final version. The complete plant drawings must be updated to reflect the plant changes made by the *Contractor.*
2. In cases where the plant drawings are not sufficiently clear, the *Contractor* shall contact the *Employer* for clarity.
3. All Drawings to be provided shall be in accordance with the Engineering Drawing Standard – Common Requirement (240-86973501).
4. The general oil purifier skid drawings should contain all applicable data and technical specifications.
5. The following general requirements apply to all the drawings:
   - Space shall be provided for *Employer* approvals.
   - All drawing revisions must be provided as paper copies in original (as per Engineering Drawing Standard – Common Requirement (240-86973501), but in all cases, at least A3 size) as well as provided in pdf format and original micro station format.
6. All C&I drawings will be updated by the *Contractor* as per VDSS (refer to Appendix) to reflect all changes made to the plant – refer to Appendix A for the applicable drawings. The drawing standards stated in section 3.3 will apply with regards to updating mechanical, C&I, civil and electrical drawings.

4.6 DOCUMENTATION REQUIREMENTS

1. All documents supplied by the *Contractor* shall be subject to the *Employer's* acceptance. Documents such as detail design report, QCP's, method statements and other documents impacting the *Works* must be accepted by the *Employer* at least 14 working days prior to commencement of the *Works*.
2. Each revision of a document or drawing shall be accompanied with a list of the comments made by the *Employer* on the previous revision if applicable and the response/corrective action taken by the *Contractor*. Changes will be recorded in a revision table contained on/in each drawing/document.
3. Documents and drawings shall indicate the *Employer's* reference number as allocated by the *Employer*. The *Contractor* may have his own document or drawing number on the document or

drawing, but where reference is made among documents or drawings, the *Employer's* number shall be used.

4. The *Contractor* shall compile a complete data book for all *works* done containing the following as per VDSS:
    - Scope of work.
    - Detail design report.
    - Approved QCPs.
    - Inspection reports and procedures.
    - As built drawings.
    - Material summary that gives full traceability between components used, assembly drawings, material certificates and complete ordering information.
    - Pump performance curves.
    - Control philosophy and alarms.
    - Maintenance, operating and troubleshooting documentation of all new plant equipment installed (as a minimum).
    - Mechanical assembly drawings of installed main turbine and BFPT oil purifier skids.
    - Wiring drawings of the installed main turbine and BFPT oil purifiers.
    - Cable test results.
    - As built Cable Schedules as per the Employer's 240-56176097: Electrical Cable Schedule Template.
    - Electrical load list as per the Employer's 240-56227927: Electrical Load List Template.
    - Control panel GA, single line diagrams, schematics.
    - Updated switchgear schedules (drawing 0.63/5049) where necessary.
    - Earthing test results and drawings indicating earth connection points for the new equipment.
    - All NCR's and corrective actions (Contractual Defect Notifications).

4.7 CONFIGURATION MANAGEMENT AND DOCUMENT MANAGEMENT

Transmittal letters shall be provided with each document submittal. The transmittal letter shall include the *Contractor's* document/drawing number, revision number, and title for each document/drawing attached. Each document/drawing title shall be unique and shall be descriptive of the specific document/drawing content.

4.8 MECHANICAL *WORKS* TO BE EXECUTED BY THE *CONTRACTOR*

4.8.1 Detail Design Works

1. The *Contractor* shall do a detail design of the main turbine oil purifier with a minimum operating flow rate of 13 700 l/hr and a rated capacity of 18 000 l/hr. The main turbine oil purifier must be a centrifuge. Table 1 shows the required minimum specifications based on the existing oil purifier skid.

Table 1: Main Turbine Oil Purifier Requirements

Item	Component	Specification

1	Pump and motor	Screw pump, 50 Hz, 7.5 kW, Protection IP 55, insulation class F, 380 V
2	Separator motor	50 Hz, 18.5 kW, Speed 2890 rpm, Protection IP 55, insulation class F, 380 V
3	Heater	64 kW

2. The *Contractor* shall optimise the design of the main turbine oil purifier to meet the specified flow requirements and fit in the plant without modifying the current pipework. The oil purifier skid pipework must comply with the EN 13480-3 design code. The current oil purifier piping interfaces are as follows:
    - The suction line is a 65 NB pipe.
    - The discharge line is a 40 NB pipe
    - The drain line is an 80 NB pipe.
3. The *Contractor* shall do a detail design of BFPT oil purifier with a minimum operating flow rate of 2 800 l/hr and a rated capacity of 4 100 l/hr. The BFPT oil purifier must be a centrifuge. Table 2 shows the required minimum specifications based on the existing oil purifier skid.

Table 2: BFPT Oil Purifier Requirements

Item	Component	Specification
1	Pump and motor	Screw pump, 50 Hz, 2.3 kW, Protection IP 55, insulation class F, 380 V
2	Separator motor	50 Hz, 3 kW, Speed 2890 rpm, Protection IP 55, insulation class F, 380 V
3	Heater	36 kW

4. The *Contractor* shall optimise the design of the BFPT oil purifier to meet the specified flow requirements and to fit in the plant without modifying the current pipework. The oil purifier skid pipework must comply with the EN 13480-3 design code. The current oil purifier piping interfaces are as follows:
    - The suction line is a 40 NB pipe.
    - The discharge line is a 40 NB pipe.
    - The drain line is a 20 NB pipe.
5. The *Contractor* shall send the detail design package (main turbine and BFPT oil purifiers) to the *Employer* upon completion for acceptance
6. The *Contractor* shall manufacture/procure the new main turbine and BFPT oil purifiers once the design packages have been accepted.
7. The *Contractor* will conduct FATs for the new oil purifier skids before installation in the presence of the *Employer's* representatives. Dirty lube oil will be purified using the new oil purifier skids. The *Employer* will provide the *Contractor* with the dirty lube oil required for the FATs. The results of the FATs must show that the new oil purifiers meet the specified flow requirements and can purify dirty lube oil to the station's specifications (water concentration and cleanliness).

4.8.2 Installation and Commissioning

1. The *Contractor* to supply a method statement for installation of the main turbine and BFPT oil purifiers. The method statement is to be reviewed and accepted by the *Employer* before installation of the new equipment can commence. The method statement to include the following documents as a minimum:
    - Oil purifier removal and installation procedure (including rigging and scaffolding requirements).
    - Commissioning procedure (Mechanical, C&I and electrical respectively). The commissioning procedure should contain – similar to the manufacturing and installation QCP's – detailed intervention points. Opportunity should be afforded to the *Employer* to review, comment, insert hold and witness points and acceptance prior to commencement of commissioning.
2. The *Contractor* shall remove the current main turbine and BFPT oil purifiers.
3. The *Contractor* shall install the new main turbine and BFPT oil purifiers.
4. Commissioning of the new main turbine and BFPT oil purifiers will be done by the *Contractor* with involvement from the *Employer*'s representatives.
5. The *Contractor* should provide the *Employer's* representative with all the design package drawings, technical data and manuals (operating and maintenance) for the main turbine and BFPT oil purifiers upon completion of the installation. Where required this information will be updated and be submitted in "as-built" status.

4.9 C&I *WORKS* TO BE EXECUTED BY THE *CONTRACTOR*

1. The *Contractor* provides an off the shelf skid solution that meets the *Employer's* requirements. The *Contractor* notifies the *Employer* of any potential customization of equipment. Customizations will be subject to approval by the *Employer,* before the Contractor undertakes the customization.
2. The *Contractor* provides an Oil purifier skid solution that is equipped with locally available spares. The Oil purifier skid must have local support for future maintenance, commissioning etc. activities.
3. The *Contractor* provides a Control and Instrumentation solution as per LOSS diagram found in Appendix A
4. The *Contractor* provides the *Employer* with the design documentation as per VDSS.
5. All control and instrumentation equipment provided by the *Contractor* should be suitable for the current environment of exposure, with dust, temperature, humidity, water ingress and vibration taken into account. C&I equipment provided is be rated at IP65 minimum.
6. The presently configured oil purifier skid alarms are shown in Table 3. The currently obsolete control system can only accommodate two alarm signals per oil purifier skid. The *Contractor* implements his standard-design alarm interface solution, but common's out the alarms, in order to be compatible with the limitations of the current system (i.e. only two alarms can be sent to control system per skid), so that the existing control system remains unaffected. The new alarms are selected based on the *Contractor's* skid design and operating philosophy and it is not required to have the same alarm descriptions that are provided currently.

    It is required that the *Contractor's* design retains the current alarm / signal tags.

    The *Contractor* submits an alarm philosophy that details operator action, alarm priority, etc as per Alarm Rationalization Guideline for all alarm signals, refer to VDSS.

Table 3: Current Alarm Signals for the Oil Purifier Skids

Plant	Incoming Signal	Alarm on Desk

Main Turbine	SC16W001 XG01	M TURB OIL PURIFYING PLANT ALARM	SC10U200 XU08	M TURB OIL PURIFYING PLANT DISTURBANCE
	SC16W001 XG52	M TURB OIL PURIFYING PLANT MCB FAILURE		
BFPT	SC56W001 XG01	BFPT OIL PURIFYING PLANT ALARM	SC50U200 XU08	BFPT OIL PURIFYING PLANT DISTURBANCE
	SC56W001 XG52	BFPT OIL PURIFYING PLANT MCB FAILURE		

7. The *Contractor* shall re-terminate new replacement instrument cables as per the current design (refer to Appendix A). The alarm cable runs from the purifier terminal strip in the field, to a field Junction Box and then to the C&I cubicle which is located in the unit C&I equipment room. Only the replacement of the instrument field cable between the oil purifier terminal strip and Junction Box is part of the Scope (refer to Appendix B LOSS Diagrams). Table 4 shows the full loop details.

Table 4: C&I Loop details for oil purifier alarm signals

	LOOP CONFIGURATION DETAILS									
Signal	**Field (Skid)**		**Field Cable**		**Junction Box & Terminal No**		**Trunk Cable**		**Cabinet (S400)**	**LOGIC and ALARM**
SC16W001 XG01	SC16B001 (See wiring diagrams for pins)	-	U2414	-	KT13C (13,14,15)	-	U21401	-	HC08 Rack E	See S200 and S300 Drawings in Appendix A
SC16W001 XG52					KT13C (50,51,52)		U21402			
SC56W001 XG01	SC56B001 (See wiring diagrams for pins)	-	U2467	-	KU11C (34,35,36)	-	U21406	-		
SC56W001 XG52					KU11C (68,69,70)		U21407			

8. The *Contractor* provides signal isolation, in the form of potential free contacts, for the hardwired alarm interface to the *Employer's* equipment. The alarm contacts must be provided as double contacts, i.e. have both NO (Normally Open) and NC (Normally Closed).
9. For oil purifier skid solutions that are provided with PLC controllers, the following needs to be complied to:
    - PLC engineering tools must be provided to enable the Employer to perform diagnostics and maintenance functions.
    - The Contractor provides in-depth PLC specific training, covering all aspects of engineering and maintenance, to enable the Employer to be proficient in engineering and maintenance of the control equipment.
    - Recommended spares list of control equipment (including but not limited to controller, IO cards, communication modules etc.)
    - Logic diagrams must be provided
10. Installation of the oil purifiers is required to comply with the *Employer's* standards.
11. The two alarms going to the operator and displayed on the operator's desk will remain as:

- Main Turbine Oil Purification disturbance alarm
- BFPT Oil Purification disturbance alarm

12. As part of commissioning, full loop tests are required for the signals in Table 3 in order to verify the signal integrity.
13. Wire break monitoring is required on the loops which will be reinstated under this project. The wire break monitoring shall be designed as per the loop drawing and resistor datasheet attached in Appendix A.
14. The drawings in Appendix A are required to be updated to reflect the new design. Drawings and documentation to be generated by the *Contractor* as per attached VDSS, but are not limited to:
    - Controller Cubicle layout drawing
    - Loop drawing
    - Termination drawings
    - Cable Schedule
    - Wiring diagrams
    - Junction Box drawings
    - Signal list (Hardwired Interface)

4.10 ELECTRICAL *WORKS* TO BE EXECUTED BY THE *CONTRACTOR*

The electrical *works* is limited to the power supply, cabling and local control panels. Furthermore, earthing requirements and motor requirements are specified. The *Contracto*r's scope includes disconnection, manufacture/ procure, supply, installation, quality assurance, commissioning and handover of the electrical *works* described herein; applicable to all 6 units.

4.10.1 Power Supply and Cabling

1. The existing power supply points and cables shall be re-used as far as practically possible for the new oil purifiers. The *Contractor* shall assess if the existing power supply (inclusive of fuses and cables from the *Employer*'s switchgear) is adequate for the new oil purifiers' specifications. Should the cables, fuses and fuse holders be inadequate, the *Contractor* shall correctly size the new components; these shall be reviewed and accepted by the *Employer* before procurement can commence.
2. The existing power supply details for each unit are detailed in Table 5:

Table 5: Existing power supply

Power Supply	Main Turbine	BFPT oil purifier
Supply point	0*CA 380 V Unit Board *A	0*CA 380 V Unit Board *A
Circuit	043	008
Fused switch and fuses	400 A	100 A
Cable	185 mm^2, 4 core, PVC SWA	35 mm^2, 4 core, PVC SWA

3. The *Contractor* shall disconnect and secure the power cables in the field during the decommissioning and removal of the old oil purifiers and reconnect them on completion of the installation of the new oil purifiers.

4. Should the orientation of the new oil purifiers change and the existing cable slag is insufficient, the *Contractor* shall supply and install a junction box and interconnecting cables to the local control panel (LCP).
5. Where the new proposed equipment is rated less than the existing equipment, the *Contractor* shall test and re-use the cables provided the test results are satisfactory and the cable length is still adequate. For the new proposed equipment rated higher than the existing equipment, the *Contractor* shall assess the existing cables in terms of cable ratings, condition and length to determine if there is a need for cable replacement. Any additional cables from the LCPs to various loads based on the detail design shall be supplied and installed by the *Contractor*.
6. The cables from the LCPs to various oil purifier loads shall remain as is, unless there is a requirement to replace them due to cable condition, length and/or rating from the outcome of the assessment to be done by the *Contractor*.
7. Cabling scope shall comply with the *Employer*'s 240-56227443 Requirements for Control and Power Cables for Power stations Standard. All necessary tests shall be conducted on existing and any new cables, in accordance with this standard.
8. The *Contractor* shall ensure the cables are provided with durable cable numbers in accordance with the E*mployer*'s 240-56227443 Requirements for Control and Power Cables for Power stations Standard.

4.10.2 CONTROL PANEL Construction and Functional Requirements

- The *Contractor* shall ensure that the main turbine and BFPT oil purifier local control panels adhere to the following minimum requirements during the detail design and manufacturing phases:
- Accessible live parts inside the CONTROL PANEL shall have a degree of protection of at least IP2X.
- For maintenance purposes, padlocking facilities shall be installed for all switch disconnection devices and provided both on the outside and the inside of the section or sub-section to lock the switch-disconnecting device in the isolated position.
- AC busbars are colour coded RED, WHITE & BLUE for the phases and BLACK for neutral busbar.
- DC busbars rated at 220 V shall be colour coded RED, for the positive conductor and BLACK for the negative.
- DC busbars rated at 24 V shall be colour coded RED, for the positive conductor and BLUE for the negative, and the zero bar shall be colour coded BLACK (where required).
- Collection busbars need to be constructed where SCPD's (Short Circuit Protective Device) and MCBs need to be connected in cascaded circuits. Collection busbars shall be rated for the full prospective short-circuit rating and equal to the de-rated current rating of the supply SCPD.
- Earthing or bonding to the protective earth (PE) conductor shall be applied to all doors by means of at least 6 mm^2 cross-sectional area multistrand conductors.
- The PE conductor shall be dimensioned in accordance with SANS 10142-1 with respect to the thermal stresses due to duration of short-circuit at 60 % of the CONTROL PANEL prospective short-circuit rating kA. The size of the PE conductor shall not be less than 150 mm^2. The conductor shall also be pre-drilled.
- The PE conductor shall be colour coded GREEN with a YELLOW stripe and the screened earth bar shall be left uncoloured.

- Where cables of 95 mm^2 and larger are required, they shall be provided with robust, individual, un-drilled, removable gland plates. These gland plates shall be non-magnetic in case of single core cables.
- All control wiring connected to a source of fault energy shall be capable of carrying continuously a current equal to 1,5 times the rating of the fuse protecting it and withstanding the total let-through current of the fuse under any fault condition from overload to short circuit without suffering perceptible damage.
- Only stranded conductor cable shall be used. Single or solid conductor shall not be used. Aluminium conductors shall also not be used.
- Multistrand cable with conductors of 1,5 mm^2 cross sectional area shall be used for control circuits. Wiring of circuits of up to 50 V shall be 0.5 mm^2 multistrand conductor cable.
- Wiring of the current and voltage transformer circuits shall be done by multistrand conductor at least 2.5 mm2 cross-sectional area. The circuits and shall be colour coded according to the phases to which it is connected.
- Cable used on 24 V DC control circuits shall consist of at least 1.5 mm^2 multistrand conductors.
- Joints or splices in any circuit as well as the termination of more than one conductor in one lug will not be acceptable.
- Conductors carrying currents in excess of 100 A and passing through metal shall either be all three phases (both poles of DC conductors) or the metal barrier shall be split.
- Components shall be arranged and mounted in the CONTROL PANEL in such a way that maintenance work can be performed in a safe and orderly manner.
- Control conductor sheath shall be coloured as follows:
    - BLACK for AC circuits
    - GREY for DC circuits
- Conductors of CT and VT circuits shall bear the phase colours. The neutral conductor shall be coloured BLACK.
- Control conductors shall be marked at both ends with an interlocking type of ferrule with permanent black letters impressed on a white or yellow background. The numbered ferrule shall not fall off when disconnecting the cable. Ferrules shall read in a consistent manner in both vertical and horizontal planes.
- Conductors for control wiring shall be terminated with pre-insulated compression type lugs.
- Each terminal strip mounting rail shall be provided with not less than 10% spare length with a minimum of 50 mm.
- Wiring for voltmeters shall be arranged in such a way that the CONTROL PANEL's fault free-zone's integrity will not be impaired.
- Terminal barriers shall be fitted between terminals with different voltage levels.
- All terminals shall have a flammability rating of V0 in accordance to UL 94.
- Terminals or terminating conductors associated with one functional unit shall be grouped together.
- All termination arrangement not in accordance with IP2X shall be provided with separate covers to act as shroud so that accidental contact is impossible when making off adjacent cables.
- The finished external colour of the AC CONTROL PANEL shall be G29: LIGHT GREY to SANS 1091 except for mounting plates and other support structures, which can be galvanized, or alloy cold rolled zinc steel. The base-frames shall be painted BLACK.

- The finishing coat shall be free from craters, pinholes, embedded foreign matter and other visual defects. The topcoat shall also provide complete hiding, consistent coverage and thickness, and uniform colour.
- The control panel enclosure shall comply to SANS 62208..
- Each control panel shall have a nameplate stating the following:
  - Name of the ASSEMBLY
  - Plant coding
  - Manufacturer
  - Manufacturer's address and contact telephone number
  - Contract Number
  - Standard to which it was manufactured
  - Main Busbar current rating
  - Rated operating voltage
  - Control voltage
  - Rated impulse withstand voltage
  - IP rating doors open and doors closed
  - Short-circuit rating in kA and duration in seconds
  - Form of separation of respective sections
  - Degree of Pollution
- Minimum creepage distances shall be for Pollution Degree 3, material group 111a with the specified insulation voltage.
- Rated impulse voltage shall be 8 kV for AC power components, busbars and circuits and 6 kV for AC control circuits.
- No components or equipment shall be mounted in any position where it is not visible and accessible to a viewer looking into the compartment through the door opening (fixed circuits).
- The CONTROL PANEL's metal enclosure shall have a minimum external degree of protection of IP3X in accordance with SANS 60529.
- Routine testing of CONTROL PANELS shall be in accordance with SANS 1973-3 Annex E.
- Routine tests shall be carried out on each CONTROL PANEL during the Factory Acceptance Testing (FAT), prior to dispatch and which shall serve to check for manufacturing and material defects.
- The LCP (local control panel) shall display all alarms individually to enable fault finding and diagnostics.

4.10.3 Earthing and lightning protection

- All equipment installed shall be bonded to the existing station earth mat in accordance to the *Employer*'s 240-56356396 Earthing and Lightning Protection standard. Continuity and resistivity tests shall be conducted by the *Contractor* to confirm the adequate bonding of the system. Test results shall be provided to the *Employer* for acceptance.

4.10.4 Motors

- The motors that form part of the oil purification plants shall adhere to 240 – 57617975 New Low Voltage Motors Procurement Standard.

4.11 CIVIL WORKS TO BE EXECUTED BY THE CONTRACTOR

1. The *Contractor* ensures that the new main turbine and BFPT oil purifier skids fit within the available area in their respective oil rooms during the detail design phase. The available area for the main turbine oil purifier skid is 2.8 m x 1.5 m. The area available for the BFPT oil purifier skid is 2.52 m x 1 m.
2. The *Contractor* is required to carry out a structural integrity assessment of the existing main turbine and BFPT oil purifier skid foundation plinths and reinforced concrete slabs in order to ensure that they can withstand the weight of the new oil purifier skids. The structural integrity assessment of the reinforced concrete foundation plinths and slab must be in accordance with the Eskom standard 240 – 56364545: Structural design and Engineering standard.
3. The *Contracto*r is required to submit the reinforced concrete slab and plinths assessment report and the method statement on replacement for the execution of the *works* to the *Employer* in advance of replacement commencement for review by the *Employer*'s engineering team.

4.12 *WORKS* TO BE EXECUTED BY THE *EMPLOYER*

1 The *Employer's* engineering representatives will review the detail design package, will assist with quality assurance during project execution, review QCPs, assess validity of equipment specifications against design before installation and assist with commissioning of plant.

2 The *Employer*'s operating representative will assist with testing and commissioning of the new oil purifier skids.

3 The *Employer* assigns personnel from operating, maintenance and engineering for operating, troubleshooting and maintenance training on the new oil purifiers.

5. TECHNICAL RETURNABLES

5.1 MANDATORY TECHNICAL EVALUATION CRITERIA

1. The Tenderer should provide proof that they can design, manufacture, supply and install oil purifiers that meet the minimum specifications. The proof provided should include the following:
    - List of verifiable references (Three minimum). Proof that the Contractor has designed, supplied and installed centrifuges before.
2. The Tenderer shall have a valid ISO 9001:2015 certification or Quality management system complying with ISO9001:2015.
    - ISO 9001:2015 certificate to be provided as proof.

5.2 QUALITATIVE TECHNICAL EVALUATION CRITERIA (MINIMUM THRESHOLD OF 70%)

1. Mechanical

- The Tenderer shall provide technical data for the proposed main turbine and BFPT oil purifier skids. The following information should be included as a minimum:
    - Minimum and maximum operating flow rate for the oil purifiers.

- The size (overall dimensions) of the oil purifier skids.
- Heater kW rating
- Pump and motor specifications
- Working fluid range. Types of oil that the oil purifiers can handle.

2. Electrical

- The Tenderer shall provide Conceptual Designs for Control Panels. This should include:
  - A list of all electrical loads
  - General arrangement and SLD
  - Control philosophy including supporting drawings
- Confirmation that the tenderer will comply with the Eskom Standard for Motors.
  - Signed letter from the tenderer committing to the completion of the schedule A & B before placing an order.

3. C&I

- Documentation
  - Tenderer to submit sample documentation as per VDSS deliverables.
- Interface
  - Tenderer to confirm and demonstrate that the offered solution can be interfaced to the Employer's existing Junction Boxes and Control System without requiring modifications to the *Employer's* Control System's logic and interface card.
  - Tenderer to confirm and provide evidence that the offered solution provides a local control panel that shows the individual alarms.
  - The Tenderer to confirm and provide evidence that the interface to the Employer's control system will be via potential free contacts that are change-over contacts.
  - Tenderer to confirm and provide evidence that any PLC solutions will be accompanied with documentation as per VDSS, that detail the PLC's configuration, engineering and software tools.
- Equipment
  - Tenderer to confirm and provide evidence that the supplied equipment conforms to the Employer's field equipment standards.
  - The Tenderer to confirm and provide evidence that the supplied solution is suitable, and will operate reliably in the current plant conditions (with respect to Temperature, Dust, Vibration, Humidity, Water ingress).

4. Civil

- Tenderer to submit a method statement for installation of the oil purifier skids.

5. General

- Tenderer to confirm and provide evidence that all spares are locally and readily available (not customized solutions).
- Tenderer to confirm and provide evidence that the supplied equipment is supported locally. (South Africa).

6. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Remofiloe Kubyane	Senior technologist Engineering – CoE
Teboho Pitso	Turbine Plant Engineering – Lethabo Power Station
Zesizwe Ncane	Electrical CoE
Franco Barnard	Lethabo C&I Engineering
Christoph Kohlmeyer	Chief C&I Engineer Plant CoE
Cornelius Visagie	Chief Technologist C&I PEI
Henk Mulder	Turbine CoE
Rendani Rambau	Civil CoE
Qingbo Cai	Chief Engineer-Structural design CoE
Duduzile Ramasimong	Corporate Specialist, Plant Engineering
Lindile Ntsaluba	Chief Engineer PEI
Leslie Barker	PEI Tribology
Ndzalamo Zwane	Configuration Management CoE

7. REVISIONS

Date	Rev.	Compiler	Remarks
November 2019	0	TS Pitso	First Draft of Technical Specification Report
January 2020	0.5	TS Pitso	Second draft of Technical Specification Report

8. DEVELOPMENT TEAM

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

Teboho Pitso - Lethabo Power Station Turbine Plant Engineer LDE

Zesizwe Ncane - Electrical CoE LDE

Priyanka Thakur - Senior C&I Technologist CoE LDE

Christoph Kohlmeyer - Chief C&I Engineer Plant CoE

Rendani Rambau - Civil CoE LDE

Franco Barnard - Lethabo C&I Engineering

9. ACKNOWLEDGEMENTS

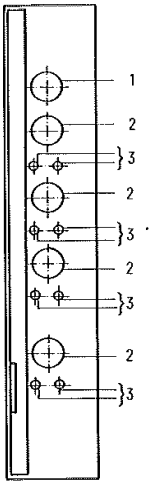
The following people should be acknowledged in the development of this document:

- All team members

APPENDIX A: EXISTING CONTROL SYSTEM DESIGN

Binary signal acquisition

GB11, GB12 and GB13 modules



1 Light emitting diode, flashes upon transmitter fault
2 Fuses
3 Test sockets

Fig. 2/1 GB11 module for binary signal acquisition (front panel identical with GB12 module)

Application

Fused power supply and monitoring of non-drive-related transmitters, e.g. pressure switches, level switches and temperature switches. Standard interface between the plant and the automatic control equipment (functional group control, protective logic).

The following can be connected to the modules:

GB11 and GB12 — 3 changeover contacts (transmitters) or – if the monitoring functions are not used – 6 single contacts (normally open or normally closed).

GB12 — 3 contactless proximity switches (BERO)

GB13 — 6 changeover contacts or 12 single contacts (normally open or normally closed).

The GB12 module is primarily used instead of the GB11 module if position indicator lamps are to be driven and tested.

For the GB11 and GB12 modules a PGP simulation and test adapter is available (page 11/15).

Functions

The signals from binary signal transmitters are converted into the signal convention used in the ISKAMATIC B process control system and additionally monitored in the GB11 and GB12 modules for various criteria. The GB13 module does not possess a monitoring facility.

Further functions of the GB11 and GB12 modules:

- Individual fusing of each binary signal transmitter (changeover contact)
- Testing of signal status at the module
- Simulation of transmitter signals (H-signal) to the modules with simulation monitoring
- Signalling of "Transmitter fault" and "Transmitter simulation"
- Non-coincidence monitoring (alarm "Transmitter fault" if a changeover contact carries a double-H or double-L signal)
- Open-circuit monitor (alarm "Transmitter fault" if the open input carrying an L-signal assumes *N*-potential in the event of an open-circuit or voltage failure or if it assumes *M*-potential in the event of an *M*-short circuit)

For this purpose a 47 kΩ transmitter test resistor GP12-2 (page 2/5) must be fitted as close as possible to each changeover contact. The current flowing through the resistor holds the open input approximately halfway between *N* and *M* potential. Any deviation in potential towards *N* or *M* is detected and signalled

- Voltage monitoring of all four fuses and the auxiliary voltage *N*
- When connecting BERO transmitters to the GB12 module, the *M*-short-circuit monitoring of the "open" line must be made ineffective by opening the jumper AB
- Each transmitter signal is available in duplex per four outputs. The GB12 module includes a lamp current amplifier per functional element.

Design

Single-height plug-in modules, 20 mm wide.

Technical Data

	Module GB11	GB12	GB13
Power supply to the module, nominal voltages, current consumption			
Supply voltage *P*		+24 V	
	60 mA[1])	120 mA[1])	240 mA[1])
Auxiliary voltage *N*		–24 V	
	15 mA[1])	55 mA[1])	20 mA[1])
Alarm voltage *PM* (fault condition)		+24 V	
	25 mA[1])	50 mA[1])	18 mA[1])
Current consumption of the inputs			
– For transmitter signals	3.2 mA + output load		
– For auxiliary signals	0.7 mA		
– For blocking of monitoring Ü2 and Ü3	0.7 mA		
Max. permanent loading capability of outputs			
– For transmitter signals	100 mA per channel		
– For alarms	7 mA		
– For contact supply voltage to transmitters	250 mA	250 mA	600 mA
– Lamp outputs	–	80 mA	–
Power loss at 30 V	3.9 W[1])	4.2 W[1])	1.6 W[1])
Voltage drop (power supply to transmitter signal output) at 100 mA and max. transmitter distance	Approx. 4.8 V		
Max. distance of transmitter	Approx. 500 m (Cu cable 0.5 mm²)		
Transmitter changeover time	≤45 ms	≤45 ms	–
Fusing	4 fuses		1 fuse,
	medium delay 0.25 A	quick-acting 0.8 A	quick-acting 0.8 A
Mounting space required	20.32 mm		
Weight	0.15 kg	0.16 kg	0.1 kg

Ordering data

		Ord. No.	Price
Module for binary signal acquisition			
GB11	For 3 changeover contacts, with transmitter monitoring circuit	**6FQ 2211-0AE**	
GB12	For 3 changeover contacts, with transmitter monitoring circuit and lamp current amplifiers	**6FQ 2212-0A**	
GB13	For 6 changeover contacts or 12 single contacts (NO contact), without monitoring circuit or lamp current amplifiers	**6FQ 2213-0A**	

[1]) Typical value for system planning.

Binary signal acquisition

GB11 module

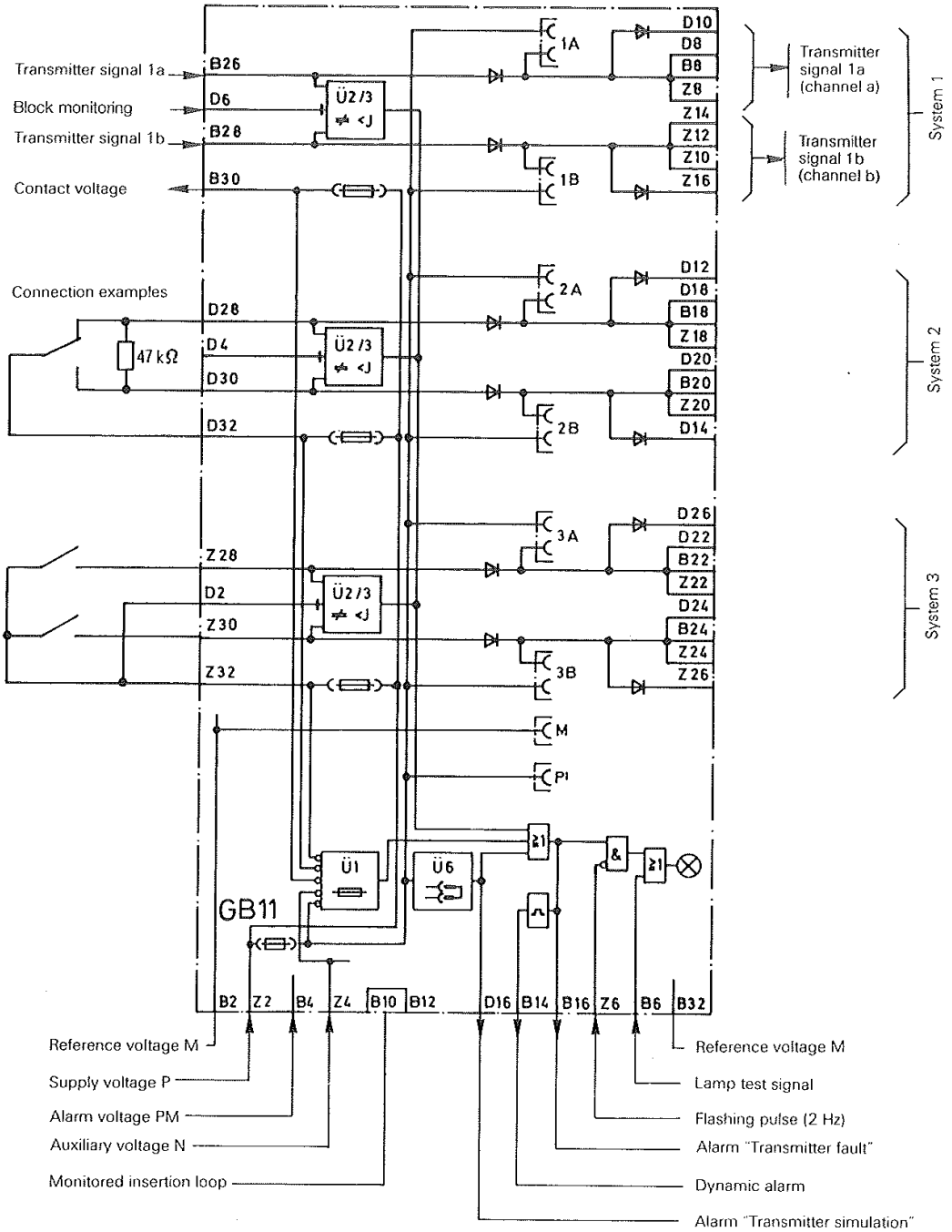
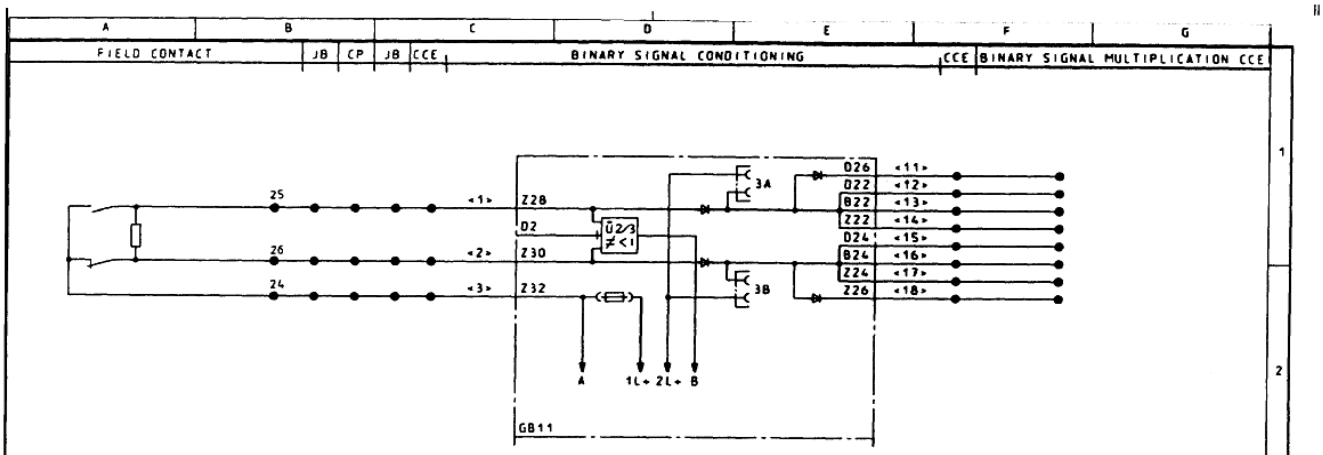


Fig. 2/2 GB11 module for binary signal acquisition, functional/connection diagram

2



LOCATION
FIELD CONTACT — JB 1KU11C, CP, JB — MODULE 1HC08C139

REFERENCE DRAWING

POWER SUPPLY AND MONITORING 1HC08C/S401
CCE-MULTIPLICATION

CON-NECT	MOD PIN	SIGNAL DESIGNATION	PIN JB	PIN CP	INPUT CCE	CON-NECT	MOD PIN	OUTPUT CCE	CCE	DESTINATION CODE	DWG
1	Z28	XG02	69		1HC08E130 :10	12	D22				
						13	B22				
						14	Z22				
						12	D22				
						13	B22				
						14	Z22				
						12	D22				
						13	B22				
						14	Z22				
						11	D26				
						11	D26				
						11	D26				
2	Z30	XG52	70		1HC08E130 :12	15	D24	1HC08F076 : 08		1SC50U200	S203
						16	B24	1HC08H088 : 16		1HU02AA067	S801
						17	Z24				
						15	D24				
						16	B24				
						17	Z24				
						15	D24				
						16	B24				
						17	Z24				
						18	Z26				
						18	Z26				
						18	Z26				
3	Z32		68		1HC08E130 :08						

ESKOM DRG. NO. 0.63/41012 — REV. 3

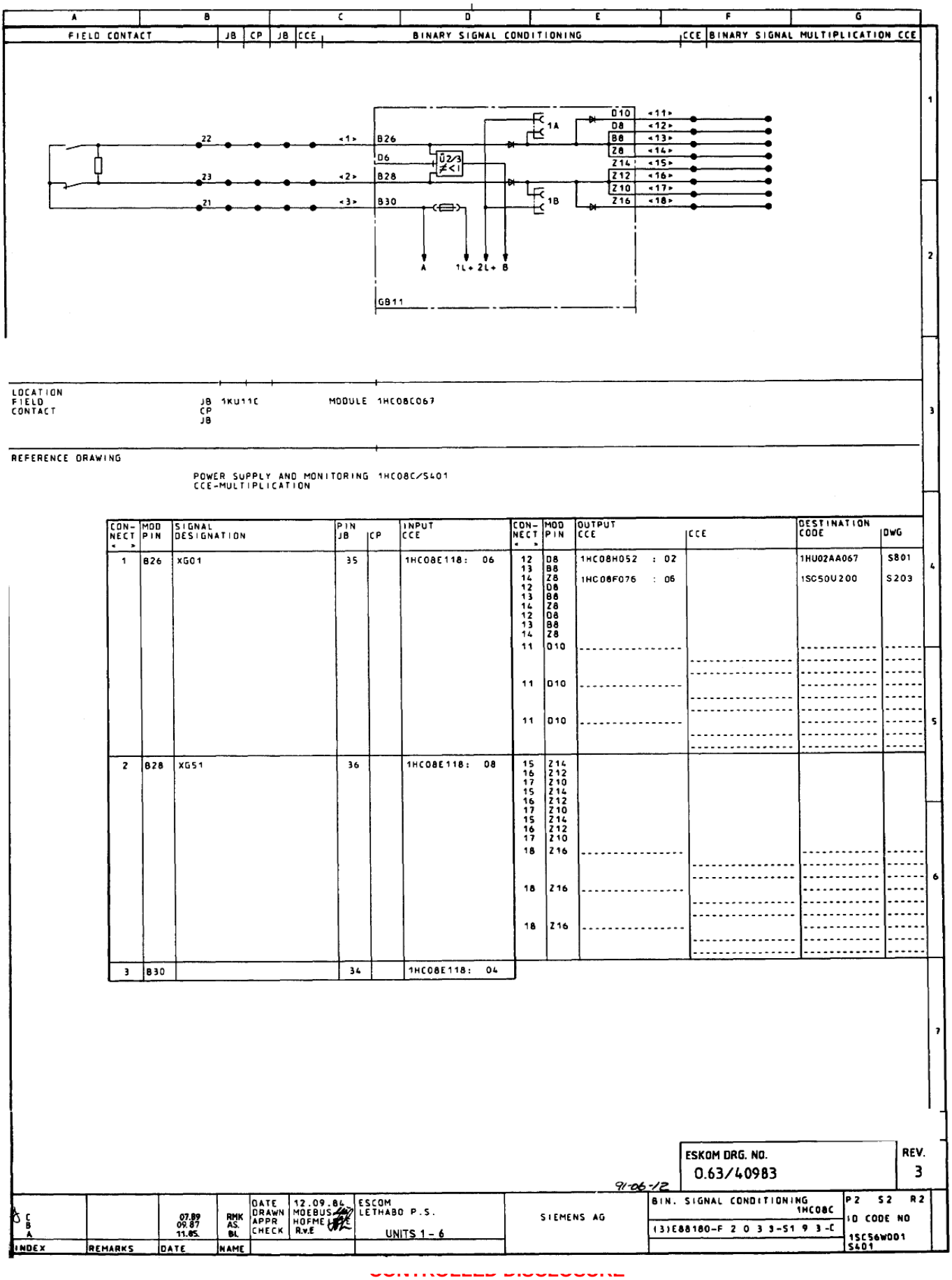
91-0648

INDEX	REMARKS	DATE	NAME			
C		07.89	RMK	DATE	21.05.84	ESCOM
B		09.87	AS.	DRAWN	HOFMEISTER	
A		11.85.	BI.	APPR	HOEFING	
				CHECK	R.v.E	LETHABO P.S.
						UNITS 1 – 6

SIEMENS AG

BIN. SIGNAL CONDITIONING 1HC08C
(3)E88180 - F2033 - S699 - C

P2 S2 R2
ID CODE NO 1SC56W001 /S402



CONNECT	MOD PIN	SIGNAL DESIGNATION	PIN JB	CP	INPUT CCE	CONNECT	MOD PIN	OUTPUT CCE	CCE	DESTINATION CODE	DWG
1	B26	XG01	35		1HC08E118: 06	12	D8	1HC08H052 : 02		1HU02AA067	S801
						13	B8				
						14	Z8	1HC08F076 : 06		1SC50U200	S203
						12	D8				
						13	B8				
						14	Z8				
						12	D8				
						13	B8				
						14	Z8				
						11	D10				
						11	D10				
						11	D10				
2	B28	XG51	36		1HC08E118: 08	15	Z14				
						16	Z12				
						17	Z10				
						15	Z14				
						16	Z12				
						17	Z10				
						15	Z14				
						16	Z12				
						17	Z10				
						18	Z16				
						18	Z16				
						18	Z16				
3	B30		34		1HC08E118: 04						

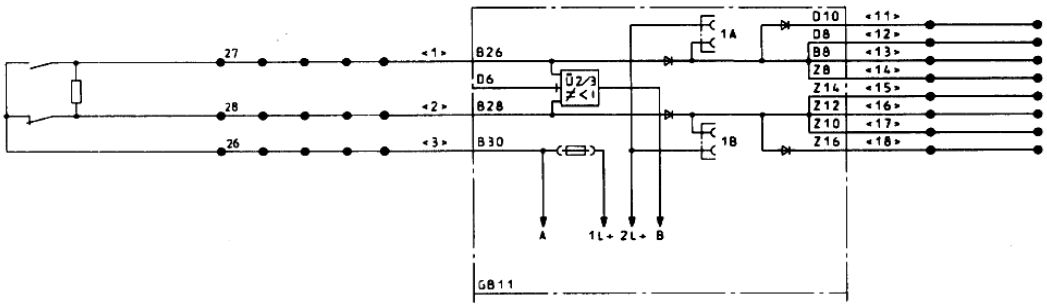
ESKOM DRG. NO. 0.63/40983 REV. 3

91-06-12

INDEX	REMARKS	DATE	NAME				
C B A		07.89 09.87 11.85	RMK AS. BL	DATE 12.09.84 DRAWN MOEBUS APPR HOFME CHECK R.v.E	ESCOM LETHABO P.S. UNITS 1 – 6	SIEMENS AG	BIN. SIGNAL CONDITIONING 1HC08C (3)E88180-F 2 0 3 3-S1 9 3-C

P2 S2 R2
ID CODE NO
1SC56W001 S401

FIELD CONTACT | JB | CP | JB | CCE | BINARY SIGNAL CONDITIONING | CCE | BINARY SIGNAL MULTIPLICATION CCE



LOCATION
FIELD CONTACT — JB 1KT13C, CP, JB — MODULE 1HC08B155

REFERENCE DRAWING

POWER SUPPLY AND MONITORING 1HC08/S401
CCE-MULTIPLICATION

CONNECT	MOD PIN	SIGNAL DESIGNATION	PIN JB	CP	INPUT CCE	CONNECT	MOD PIN	OUTPUT CCE	CCE	DESTINATION CODE	DWG
1	B26	XG01	14		1HC08E049: 12	12	D8				
						13	B8	1HC08H046 : 04		1HU02BA059	S801
						14	Z8	1HC08F040 : 06		1SC10U200	S201
						12	D8				
						13	B8				
						14	Z8				
						12	D8				
						13	B8				
						14	Z8				
						11	D10				
						11	D10				
						11	D10				
2	B28	XG51	15		1HC08E049: 14	15	Z14				
						16	Z12				
						17	Z10				
						15	Z14				
						16	Z12				
						17	Z10				
						15	Z14				
						16	Z12				
						17	Z10				
						18	Z16				
						18	Z16				
						18	Z16				
3	B30		13		1HC08E049: 10						

SCANNED

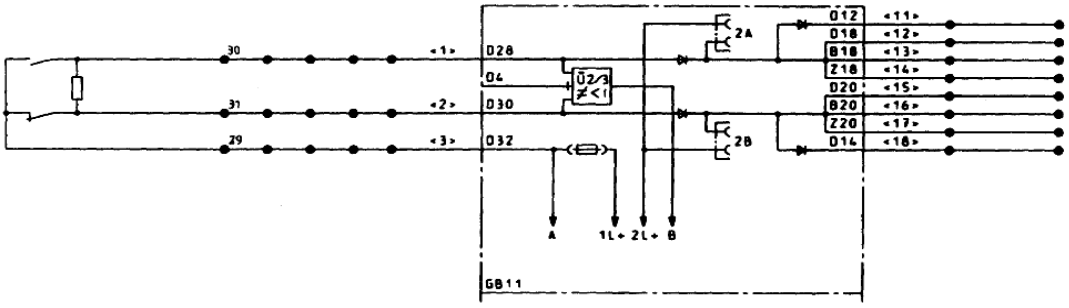
ESKOM DRG. NO.	REV.
0.63/40952	3

91-06-13

INDEX	REMARKS	DATE	NAME					
C B A		07.89 09.87 11.85	RMK AS BI	DATE DRAWN APPR CHECK	12.09.84 MOEBUS HOFMEI R.v.E	ESCOM LETHABO P.S. UNITS 1 - 6	SIEMENS AG	BIN. SIGNAL CONDITIONING 1HC08B (3)E88180-F 2 0 3 3-S1 5 8-C P2 S2 R2 ID CODE NO 1SC16W001 S401

A PATENT OR THE REGISTRATION OF A UTILITY MODEL OR DESIGN.

A	B	C	D	E	F	G
FIELD CONTACT	JB CP	JB CCE	BINARY SIGNAL CONDITIONING	CCE	BINARY SIGNAL MULTIPLICATION CCE	



LOCATION
FIELD CONTACT — JB 1KT13C, CP, JB — MODULE 1HC08B131

REFERENCE DRAWING

POWER SUPPLY AND MONITORING 1HC08B / S401
CCE-MULTIPLICATION

CONNECT	MOD PIN	SIGNAL DESIGNATION	PIN JB	PIN CP	INPUT CCE	CONNECT	MOD PIN	OUTPUT CCE	CCE	DESTINATION CODE	DWG
1	D28	XG02	51		1HC08E064 :06	12	D18				
						13	B18				
						14	Z18				
						12	D18				
						13	B18				
						14	Z18				
						12	D18				
						13	B18				
						14	Z18				
						11	D12				
						11	D12				
						11	D12				
2	D30	XGS2	52		1HC08E064 :08	15	D20	1HC08F040 : 08		1SC10U200	S201
						16	B20	1HC08H091 : 02		1HU02BA067	S801
						17	Z20				
						15	D20				
						16	B20				
						17	Z20				
						15	D20				
						16	B20				
						17	Z20				
						18	D14				
						18	D14				
						18	D14				
3	D32		50		1HC08E064 :04						

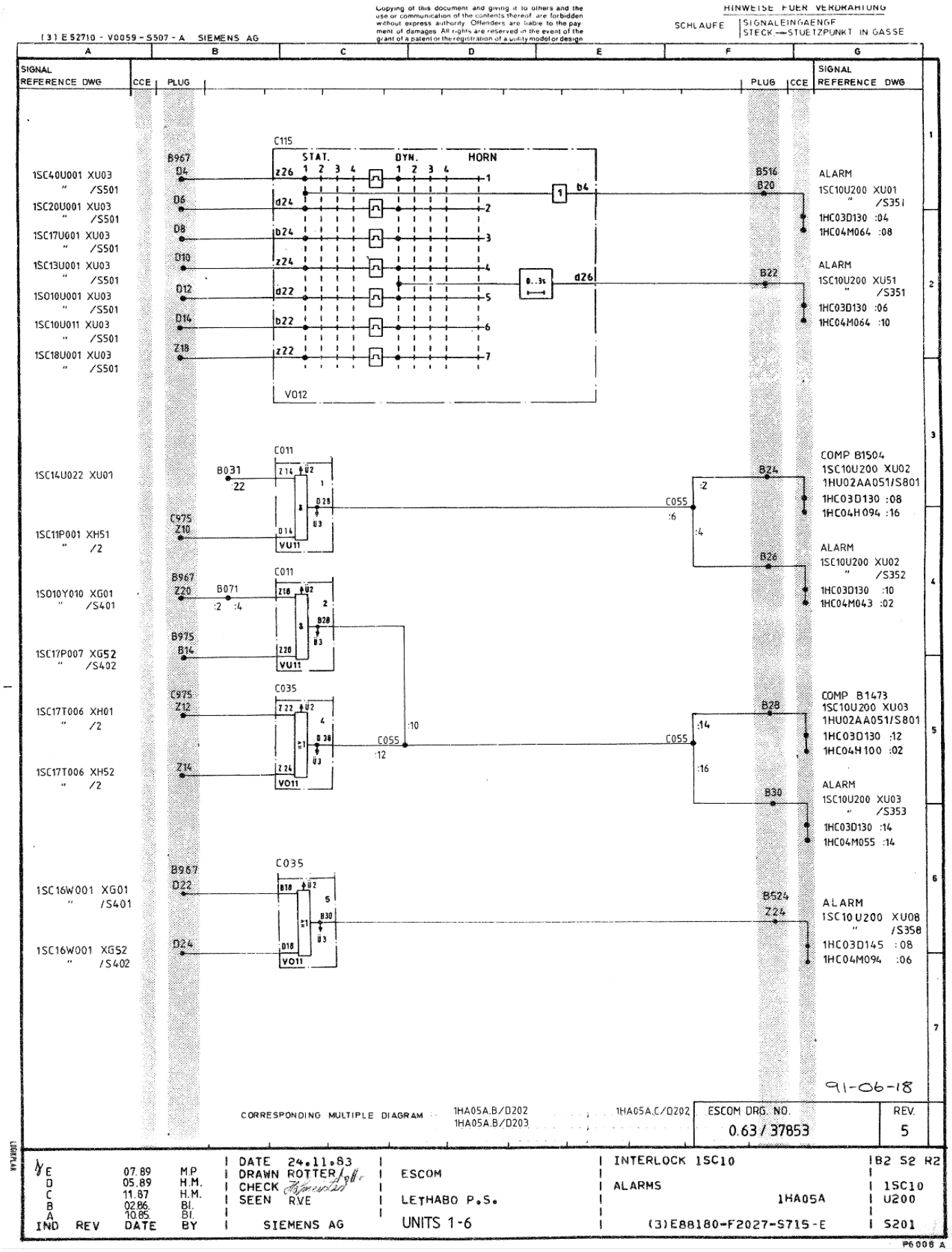
SCANNED

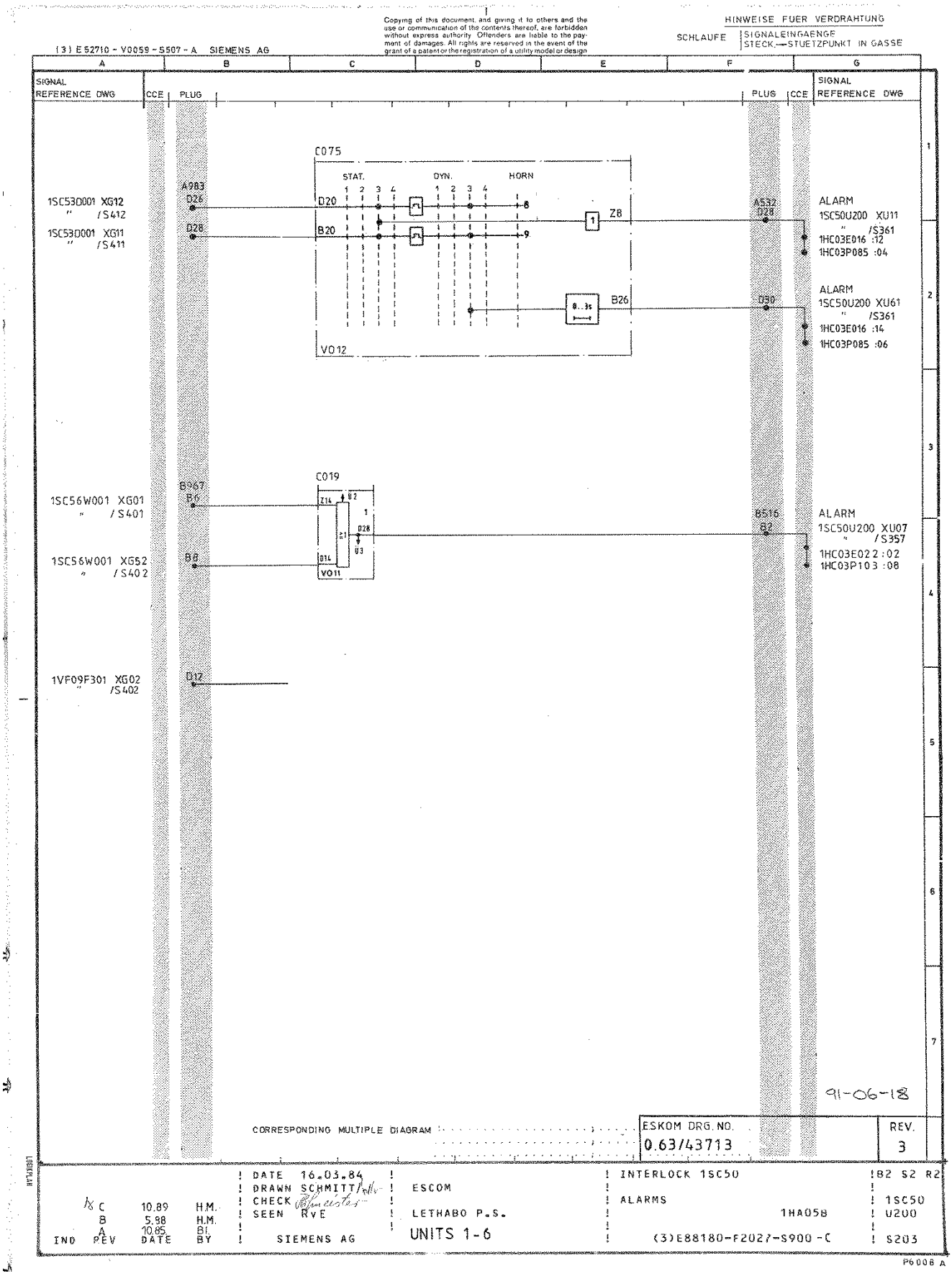
ESKOM DRG. NO.	REV.
0.63/40944	3

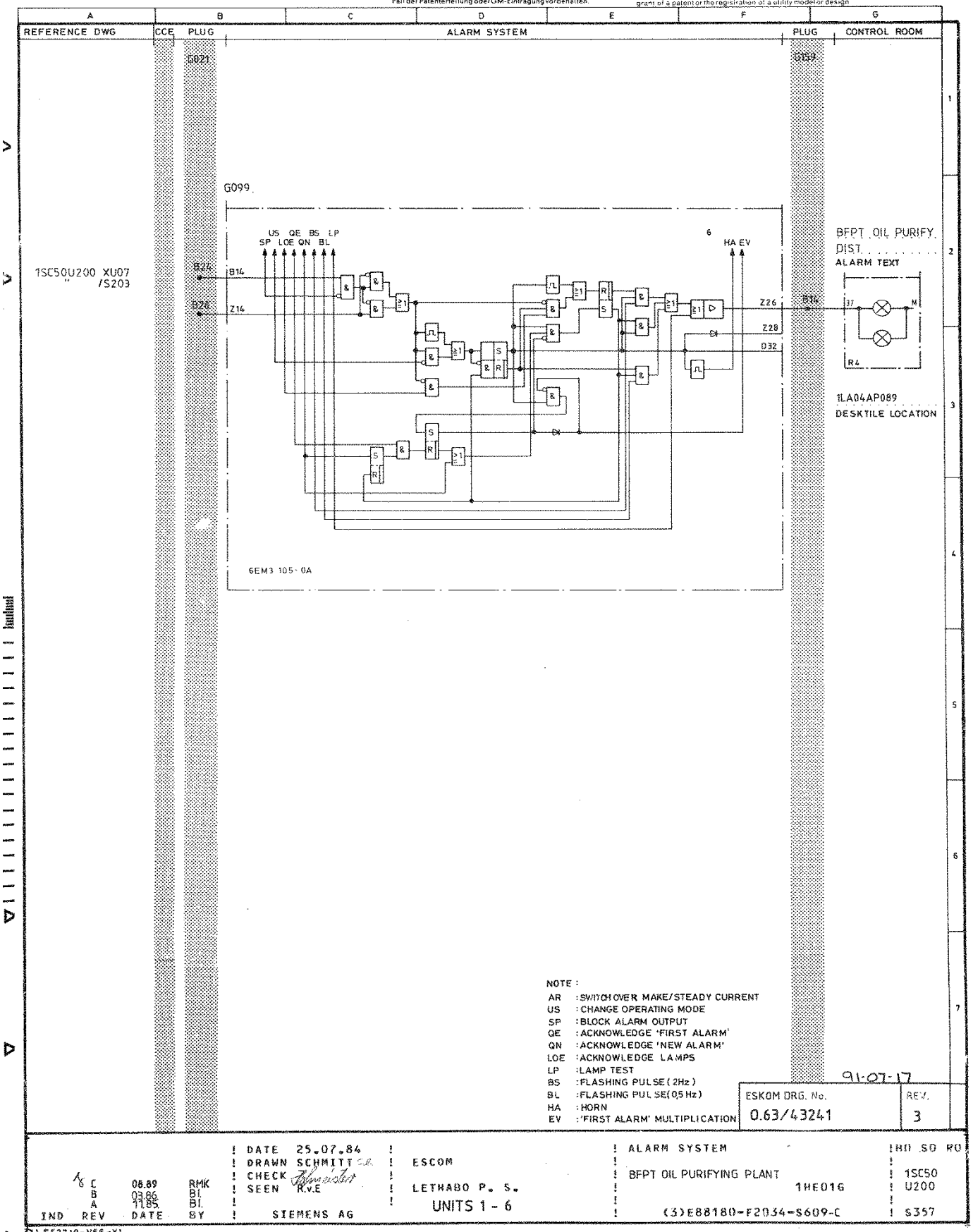
91-06-13

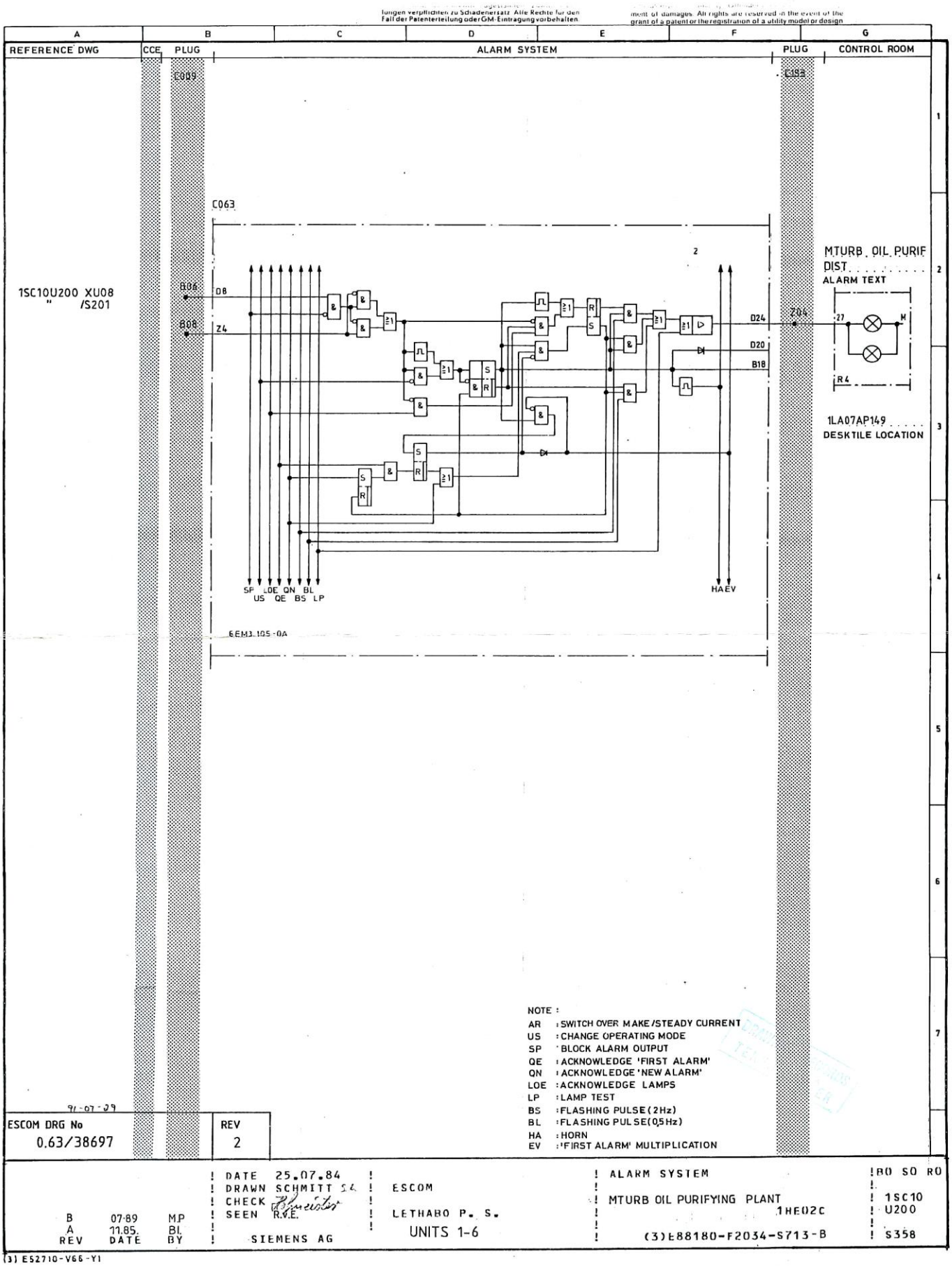
INDEX	REMARKS	DATE	NAME				
C B A		07.89 09.87 11.85.	RMK AS. BI.	DATE 21.05.84 DRAWN HOFMEIST APPR HOEFLICH CHECK R.v.E	ESCOM LETHABO P.S. UNITS 1 - 6	SIEMENS AG	BIN. SIGNAL CONDITIONING 1HC08B (3)E88180-F2033-S698-C

P2 S2 R2
ID CODE NO 1SC16W001 /S402







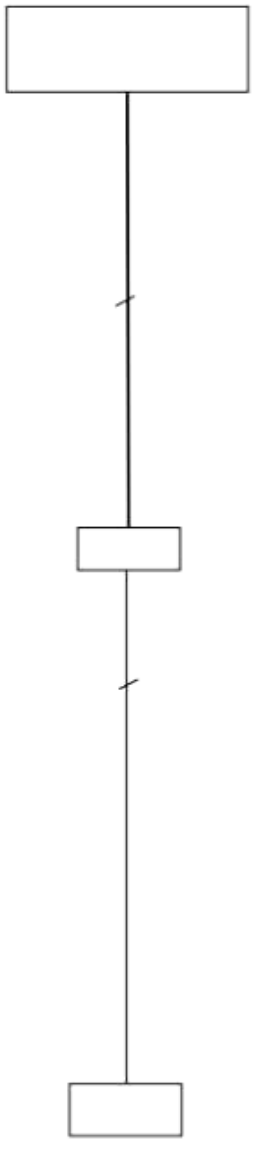


APPENDIX B: LOSS DIAGRAMS

POWER STATION	Lethabo Power Station
PROJECT	Oil Purifier Replacement Project
LOSS NAME	LOSS_OilPurifier
LOSS DESCRIPTION	Oil Purifier
LOSS TYPE	Oil Purifier LOSS Diagram
REVISION NUMBER	1
DATE LAST MODIFIED	30-Aug-19
DESIGN CHANGE REF.	When changed as part of a Design Change
ADDITIONAL REMARKS	None

LEGEND

1	C&I	5	CONTRACTOR
2	CIVIL	6	EMPLOYER
3	ELECTRICAL	7	
4	PROCESS OWNER	8	



	CONCEPT DESIGN	BASIC DESIGN	DETAIL DESIGN - SYSTEM ENGINEER	DETAIL DESIGN - PRODUCTION ENG	SUPPLY	ERECTION/INSTALLATION	COMMISSIONING	COMMENTS
CONTROL SYSTEM	1	1	6	6	6	6	6	Contractor to perform full loop checks.
TRUNK CABLE (S)	1	1	6	6	6	6	6	
JUNCTION BOX	1	1	6	6	6	6	6	Contractor to terminate new instrument cables in the existing Junction Boxes.
INSTRUMENT CABLE	1	1	5	5	5	5	5	
Oil Purifier Skid	1	1	5	5	5	5	5	