Eskom	Scope of Work	Generation

Title: **Grootvlei Power Station: Cooling Tower 2 Structural Repair Scope of Work**

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1. INTRODUCTION

Grootvlei Power Station is situated close to the town of Balfour in Mpumalanga province. The Power Station consists of six units with a capacity of 200 MW each and the total installed capacity is 1200 MW. The first of six units was commissioned in 1969. Three of the units were mothballed in 1989 and the rest in 1990. Grootvlei was one of the power stations being recommissioned. The return to service of the first unit occurred during 2007 and all six units were recommissioned during 2010. The power station is currently 51 years old.

Following a partial structural concrete collapse discovered in Cooling Tower 2, an inspection was initiated by the Grootvlei Power Station engineering to ascertain the cause, extent of damages and remedial actions required. This document provides the scope of works relating to the concrete repairs that are required at Cooling Tower 2, which will be conducted by the *Contractor*.

Figure 1: Plant layout illustrating Cooling Tower 2

2. SUPPORTING CLAUSES

2.1 SCOPE

This document covers the scope of works relating to the concrete repairs in Cooling Tower 2, where the works are to be performed by the *Contractor*. This report outlines all the requirements required to complete the repair works.

2.1.1 Purpose

The purpose of this document is to outline the minimum requirements and the scope of activities required from the *Contractor* for the execution of the works.

2.1.2 Applicability

This document applies to Grootvlei Power Station and all other stakeholders involved in the project.

2.1.3 Normative/Informative References

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

2.1.4 Normative

[1] Eskom Health, Environment and Quality (SHEQ) Policy 32-727

[2] ISO 9001 Quality Management Systems

[3] National Environmental Management Act (NEMA) 107 of 1998

[4] Construction Regulations, 2014

[5] Occupational Health and Safety Act No. 85 of 1993

[6] 240-99527377: Inspection Manual for Civil Works at Eskom's Power Station

[7] SANS 10400: The application of the National Building Regulation

[8] 240-56364545: Structural Design and Engineering Standard

2.1.5 Informative

[9] Investigation Report

2.2 DEFINITIONS

N/A

2.2.1 Disclosure Classification

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

2.3 ABBREVIATIONS

Abbreviation	Description
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
MPa	Megapascal
ITP	Inspection Test Plan
SANS	South African National Standards
BOQ	Bill of Quantity

2.4 ROLES AND RESPONSIBILITIES

Grootvlei Power Station Engineering will be responsible for appointing an appropriate *Contractor* to perform the repairs as indicated in this document.

The *Contractor* shall be responsible to deliver work according to specification.

The *Engineer* shall monitor construction quality during construction.

2.5 PROCESS FOR MONITORING

The *Contractor* submits a quality control plan for approval by *Employer*.

2.6 RELATED/SUPPORTING DOCUMENTS

Investigation Reports

Drawings

3. EMPLOYER'S OBJECTIVES AND PURPOSE OF THE WORKS

The objective and purpose of the works is to:

- Regain the overall structural integrity of Colling Tower 2 around the external periphery concrete beams, the shell, the supporting raker columns and also the inlet and outlet structures so that the full operation of the tower can continue until the refurbishment project can commence/be executed.
- Prevent further and future collapse around the periphery.

4. SCOPE OF WORKS TO BE CARRIED OUT IN COOLING TOWER 2

4.1 DESCRIPTION OF THE WORKS

The *Contractor* shall adhere to the South African Environment Protection Act, the Waste Management code of practice and the South African Occupational Health and Safety Act No. 85 (OHS Act), the regulations promulgated thereunder and Eskom Health, Environment and Quality (SHEQ) Policy 32-727 for demolition, removal, separation and disposal of scrap, waste and hazardous materials.

The cooling tower shell was constructed with the ring formwork and the pouring was done in multiple lifts of approximately 1.2 m to create a double curve hyperbolic shape, with internal and external reinforcement. The shell concrete cover to the reinforcement according to the design drawings is of 35 mm. The shell is supported by the Raker columns resting on concrete block foundation on the pond basin. The Cooling tower internal consists of concrete precast columns, beams, walkways and asbestos fill. This project has been initiated following a structural investigation which was recently done by the Consultant. During the assessment, it was observed that a concrete corbel failed and resulted in collapse of beams and columns.

The work shall consist of:

- Safe removal and disposal of concrete rubble.
- Repairing of damaged precast reinforced concrete beams and columns
- Fabricate, supply and install knee-bracing steel frames.
- Procurement of all materials required to complete the works.
- Provide all necessary equipment, including safety equipment, tools and materials required for the works.
- Ensure that surrounding equipment and structures are not damaged during execution.
- Supplying material and the mixing and placing of the chosen repair product as described on the product manufacturer’s application manual and this specification.
- Supplying, fabricating, constructing, maintaining and removing temporary works, including false work and formwork.
- The quality control (QC) testing of all material.

Refer to appendices for drawings, concrete repair method and bill of materials.

4.2 EMPLOYERS DESIGN

The Employer has performed an investigation on Cooling Tower 2 to assess the extent of the deteriorated and collapsed reinforced concrete structures. The following was observed:

i. The collapsed beam appears to be a result of a poor design with that the corbel was design with corners which caused stress concentration.

ii. Several failed corbels in the past. This can be observed through the number of retrofitted knee-bracings which are already installed.

iii. The condition of concrete for columns and periphery beam (corbel) show a number of defects (concrete spalling and cracks) which will require urgent attention.

4.3 CONTRACTOR'S REQUIREMENTS

4.3.1 General

1. The Contractor takes full accountability and liability for the works as described in the scope of works.
2. The Contractor is required to confirm and verify all information supplied by the Employer prior to being using in the works.
3. The Contractor adheres to all design requirements, codes of standards and regulations stated in this scope of works and that are applicable.
4. Any discrepancy or ambiguity between the Employer's Specifications or requirements is to be immediately brought to the attention of the Project Manager for clarification.
5. Where the Contractor requires additional information to design or install certain components of the Plant, the Contractor notifies the Project Manager of the Contractor's requirements a minimum of one (1) week before continuing with the works.
6. Any damages to existing infrastructure and services resulting from the works is repaired/ made good by the Contractor at his own expense. This is subject to the Contractor supplying a method statement for the repair works to the Project Manager for review and acceptance prior to conducting the repair works.
7. The Contractor quantifies the limitations and risks in the form of a detailed risk assessment, which is reviewed and accepted by the Project Manager prior to commencing with construction work.

4.3.2 Concrete Repairs to Beams and Columns

1. The Contractor is required to remove all the concrete rubble.
2. All concrete defects (e.g. spalling, cracks, etc.) observed on the beams and columns are to be repaired as per the recommended repair method.
3. The Contractor is required to conduct corrosion and pH testing on all reinforced concreted structures as per scope of works
4. All concrete surfaces to be repaired are to be sandblasted and neutralised by lime washing prior to concrete repairs.
5. Reinforcement that are severely corroded are to be replaced with new reinforcement with similar properties. All exposed reinforcements, including newly installed rebar, are to be coated with a layer of Zinc primer prior to the application of concrete mortar.
6. The Contractor ensures that the profile, cross section and finish level of all repaired concrete beams are as per original design to allow for the re-installation.
7. Prior to any concrete repairs, the Contractor ensures that surface preparations (e.g. removal of dust, debris, water, etc.) is complete for defects to be repaired.

4.3.3 Fabrication, Supply and Installation of knee-bracings

1. The Contractor is to fabricate, supply and install galvanised steel knee-bracings and related materials as illustrated in the drawing.

2. All fabrication work to be done off site.

3. The contractor to verify dimensions for bracings on site prior to fabrication. A sample to be presented to the employer for approval before installation.

4.3.4 Remedial work on other parts of the Cooling Tower

1. Repair the spalled concrete on the periphery beam to the specification set out
2. Repair the spalled raker columns around the tower to the specification set out
3. Repair the damaged concrete on the inlet and outlet structures (Concrete channel) to the specifications set out

4.4 CONSTRUCTION

4.4.1 General

The *Contractor*:

1. Adheres to the South African Environment Protection Act, the waste management code of practice and the South African Occupational Health and Safety Act No. 85 of 1993, the regulations promulgated thereunder and Eskom Safety, Health, Environment and Quality (SHEQ) Policy 32- 727 and Waste Management Procedure, as well as the National Building Regulations and SANS 10400 for all works.

2. Submits a comprehensive method statement (including a comprehensive risk assessment) detailing the proposed methods for the entire works to the *Project Manager* for acceptance prior to the start of the works. Refer to Section 4.4.5 for method statement requirements.

3. Submits a project specific safety file to the *Project Manager* for comments / acceptance.

4. Submits a detailed level 3 schedule for the *works* to the *Project Manager* for acceptance after contract award.

5. Takes all necessary precautions to ensure that none of the existing structures / facilities not forming part of the *works* is damaged during construction. The *Contractor* is liable for all damages that may occur and repairs are to be done at no additional cost to the *Employer*.

6. The *Contractor* disposes of all waste material at a waste disposal site to be approved by the *Project Manager*. The waste disposal site is selected to suit the classification of the materials to be disposed of. Certificates of disposal are required to be submitted to the *Project Manager*.

7. Continuously monitors the conditions within the working and surrounding areas for any hazardous substances or situations, and in such case, the *Contractor* is required to take necessary precautionary measures.

8. Manages access to the working areas and the Site.

9. Manages access to the working areas and the Site.
10. Manages activities on Site to ensure that no interference takes place between the *works* and that of others.
11. The *Contractor* is responsible for the design and erection of all the temporary supports require for the *works*. In addition to the aforementioned, the *Contractor* adheres to the following:

- The *Contractor* is restricted to the designated working areas
- The *Contractor* is not to enter any other areas and ensures that his employees abide by the applicable regulations
- The *Contractor* performs all hoisting and lifting by qualified riggers
- The *Contractor's* Equipment does not impair the operation or access to the plant/building
- The *Contractor* provides any temporary or expendable materials required for the storage of materials

- The *Contractor* safeguards and secures all items whilst in the *Contractor's* custody and control, until completion of the works;
- Plant and equipment not forming part of the *works* are not to be modified without written permission from the *Project Manager*. Modification in this sense includes, but is not limited to the following:
  - Welding onto existing plant,
  - Drilling into structural steel or concrete,
  - Cutting or removing
  - Loading adjacent structures.

12. The Contractor ensures that a complete QCP, risk assessment, method statement and ITP's, where applicable are submitted to the *Project Manager* for review and acceptance before the works can commence. During reviews of the ITP's, the *Project Manager* provides the necessary intervention points.

13. All items that are assembled and constructed off site are listed and provided to the Pro*jec*t *Manager*. From this, an ITP is developed between the Project Manager and the *Contractor* to determine the intervention points.

4.4.2 Construction, Erection and Monitoring

1. The *Contractor* is responsible for the construction of all *works* in accordance with the accepted designs, drawings, and specifications.

2. The *Contractor* is responsible for the safety of all personnel involved in the *works* as well as the safety of all personnel at Grootvlei Power Station affected by the construction of the *works*.

3. The *Contractor* is required to confirm all site dimensions, levels and cast-in items positions on site prior to any fabrication of steel members.

4. The *Contractor* notifies the *Project Manager* of any defects that have occurred or are foreseen in order to reduce further damages that may occur.

5. The *Contractor* is responsible for the design, erection, maintenance, and removal of all temporary works required for the execution of the *works*. Refer to Section 4.4.1 for requirements for temporary works.

6. The *Contractor* takes full professional accountability and liability for all temporary items required for the execution of the works.

4.4.3 Plant and Material Supply

1. The *Contractor* provides all tools and equipment for the handling of material and the proper execution of the works.
2. The *Contractor* takes reasonable care to ensure that equipment used does not cause damage to any existing infrastructure. In the event that such damages do occur to the surrounding infrastructures, the *Contractor* is responsible for repairing such damages and is liable for all costs associated with the repairs.
3. The *Contractor* is to supply, deliver, offload and temporarily store (as may be required) all materials needed to carry out the works.

4.4.4 Storage Facilities

1. The *Contractor* is to make his own arrangements with regard to storage facilities and laydown areas that are required to complete the works. All laydown areas on Site are as per agreement with the Project Manager.
2. All storage facilities (Plant, Material and Equipment) will be within the boundaries of the Site in order not to affect the operations of Others.

4.4.5 Method Statement

1. As a tender returnable, the *Contractor* submits a general Construction Work Method Statement taking into consideration the various phases of the project.
2. This Method Statement clearly illustrates how the Contractor accounts for the risks of this project and is tailored to address the specified project objectives and requirements.
3. The Method Statement includes, as a minimum and where applicable, the following:

- Constraints identified and considered by the *Contractor*.
- Interfacing with Others; the Contractor illustrates an understanding of the work that is to be completed by Others and accommodates for the completion of such work in his methodology.
- Description and illustrations of a construction traffic plan, use of laydown areas and plot plan.
- Shifts and hand overs for the various sections of the works, this information is to enable the *Employer* to integrate the programmes of the various contractors.
- Design tools and systems that the *Contractor* plans to use.
- Construction methodology and sequence of construction taking into consideration access restrictions and safety requirements.
- Detailed risk assessment which lists risks specific to the works and is accompanied with associated proposed mitigations.
- List and description of plant and machinery required to carry out the civil and structural components of the works.
- Inspection and quality control plan.
- A clear description of the responsibilities of the Contractor’s personnel involved with the works, including (where applicable) his Project Manager, Site Quality Manager, Site Engineer, Health and Safety Manager, Technical Office Manager, Production Manager, Supervisor, Environmental Officer, Fabricator, Erection Engineer, Shop detailer,Transporter and other personnel required for the civil and structural works.
- Construction sequencing considerations, which take into account any constraints.
- Health, safety and quality control for the activity.
- All plant, equipment and machinery required to complete activity.

- Manufacturer's literature/ Technical Data Sheets for all materials used including product description, composition, material and performance properties, installation and application procedures, use limitations and recommendations.
- Plan for confining, collecting and disposing of waste materials as a result of removal operations, where applicable.
- Works required to safeguard existing infrastructure and services.
- A Steelworks Method Statement which describes the following as a minimum:
  - Method of fabrication and erection;
  - The physical location of manufacturing and fabrication;
  - Erection procedures which includes considerations for modularisation and construction sequencing, including a lifting and rigging plan;
  - Transportation;

4. All Method Statements are reviewed and accepted by *Project Manager* prior to commencing any work.
5. The Contractor submits a new Construction Work Method Statement, a month prior to commencing with any construction activities and after Contract Award, which covers all the aspects listed above, and any additional requirements or changes arising from negotiations or clarifications, for acceptance by the Project Manager. This Method Statement is to include interfaces with Others. This new method statement includes a sequential erection procedure which clearly shows detailed consideration for stability requirements of the structure (if applicable) at all stages during erection.

4.4.6 Constructability Analysis

1. The *Contractor* uses the *Employer's* standard: 240-107981296, Constructability Assessment Guideline to perform the constructability analysis.

2. The *Contractor* has a structured process in place for constructability analysis, for the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve the *Employer's* objectives.

3. Qualified people with adequate skills in construction knowledge and experience are involved from the beginning of the project, to maximize the benefits of the constructability analysis. This process includes examining design options, where applicable, that minimize construction costs while maintaining standards of safety, security, quality, cost and schedule, and is initiated in the front end planning process. The Contractor considers various phases of the project and demolition activities, where applicable, that includes manpower plans, organization, construction equipment usage, material storage and handling and preparation of construction facilities.
4. The *Contractor* submits a Constructability Analysis Report based on the Method Statement to the *Project Manager*, for his review and acceptance. The (first) submission of the report is submitted as part of the tender documents and clearly indicates how the Tenderer takes into account interfaces with other contractors where applicable, together with the Site and time constraints and rigging studies. This report clearly illustrates how the construction would be completed within the allowable timeframes and highlights the risks of meeting this requirement. The *Contractor* is required to plan his activities to avoid the following interface risks and any other risks relevant to the works:

- Interface issues arising from working in close proximity to Others;
- Access to Site;
- Material storage;
- Delivery;
- Other Works related risks;

5. This report clearly illustrates the construction sequencing and durations for the completion of the works within the contract period. The Contractor submits a risk assessment as part of the Work Method Statement, which is informed by the Constructability Analysis Report that advises on a proposed approach and methodology to mitigate risks described above and any other risks, which may impede successful execution of the works.
6. The second submission of the Constructability Analysis further elaborates on the first submission and is submitted one week after design completion of the works. This report is a revision on the first submission to take into account the Contractor's final design/proposal and includes consideration for modularised construction for faster construction durations.

4.4.7 Construction Programme

1. As part of the Method Statement and as a tender returnable, the *Contractor* submits a Level 3 construction programme considering all the interfaces and time constraints.
2. This programme does not omit key activities. Timing of the activities is consistent with the Construction Work Method Statement.
3. The programme is to show that the *Contractor* has a clear understanding of the full scope of works, including the accompanying risks. The programme is to be logical and realistic.
4. The Contractor submits a Programme for all the phases of the *works* to the *Project Manager* for his acceptance.
5. This programme is accompanied with the following:

- A comprehensive narrative which describes the basis of the programme;
- A list of assumptions that the programme was based on;

6. The programme clearly indicates the following:

- Activities of all the project work to be done by the *Contractor* and the other work covered by the contract that is being done by the sub-contractors;
- Logical links/ sequence/ relationships that connect the various activities together (showing all hold points);
- Master schedule is to show Links/logic, the CPM (Critical Path Method) technique is used for programme and planning. The critical path is clearly illustrated.
- The works is completed within accepted durations that are in consistence with key dates provided in the Contract Data. Milestone dates in line with Key Date/Contract Data shown on the schedule.
- Schedule Work Package Classifications (Deliverable, Engineering, Procurement, Manufacturing, Supply, Construction and Installation Work Packages)

- The amount of shifts planned per day for each section of the works.
- The way in which the *Contractor* plans to interface with Others. Interface points with Others are identified in the programme;
- A comprehensive description of each activity, including the name and designation of the responsible person;
- Full details of all terminal point release requirements;
- Any erection or commissioning activities that may affect other maintenance and construction activities on Site;
- Identifies when services are required for commissioning purposes;
- Sufficient information with regard to the activity duration and a description to enable measurement of the progress of the activity within the required update period;
- Each description in the programme explains and represents the performance of the activity, including tangible deliverables or products;
- Resources required to perform an activity for each activity that requires resource assignment;
- Single source of responsibility or ownership per activity.

4.5 DELIVERABLES

The *Contractor* provides the following document deliverables as part of the *works*.

4.5.1 Tender Phase

The tenderer submits the following as a minimum in the tender submission:

1. Method Statement (including Constructability Analysis, QCP and Risk Assessment) for the entire works clearly demonstrating understanding of and compliance with the full scope as detailed in the Scope of Works.

2. Relevant experience in installation and construction of similar projects. List of verifiable relevant references (minimum of 3 projects) must be provided for works completed within the last 5 years. References to include contact numbers and name of client, description of scope in the project and the cost of the project as a minimum.

3. CV's of the proposed key resources each having a minimum of 5 years' relevant experience (construction manager, site engineer/agent). Construction manager to be professionally registered with SACPCMP or similar professional body. Engineer/technician to be professional registered with the Engineer Council of South Africa. Copy of valid certificate to be provided. Organogram of site team to also be provided clearly indicating the roles that the resources will fulfil in the project.

4. A CIDB Grading of 2SL

4.5.2 Planning phase

1. A Level 3 schedule (schedule with defined activities) for the design scope clearly highlighting all activities involved, major milestones and provision.
2. Detailed Method Statement (including constructability analysis) for the execution of the works.
3. Risk Assessments.
4. Project specific safety file.
5. Project Quality Control Plan.

4.5.3 Pre-Construction/Installation

1. Detailed method statements for the construction of the works
2. Inspection and Test Plans (ITP's) indicating all intervention points
3. Quality Control Plans (QCP's)
4. Construction Programme
5. Project Specific Safety File (updated)
6. Any temporary works required as part of construction signed by a professionally registered Structural Engineer/Technician
7. Detailed Risk Assessments (updated)
8. Visual Assessment Report

4.5.4 Post Construction/Installation

1. QA returnables (monthly)
2. As-Built drawings
3. Safety File

5. MATERIALS

The *Contractor* is required to supply all materials necessary for the repair and restoration of deteriorated concrete areas as follows:

- Concrete repair product from the Approved Products List most closely matching the exposure conditions and properties of the existing concrete and meeting the anticipated placement requirements.
- The *Contractor* is required to supply and place additional reinforcing steel as required.
- The *Contractor* is required to supply and install structural members, cladding and roof sheeting required.
- Recommended product to be used has been described in this specification; however similar products with similar properties to the recommended product may be used.
- The *Contractor* is required to obtain approval from the *Employer* for the products and material intended to use for concrete repair.

6. CONSTRUCTION METHODS

6.1 SURFACE PREPARATION AND CONCRETE REMOVAL

Prior to any concrete repairs, the *Contractor* is required to remove all dust, dirt, water and debris from the surface of the concrete to be repaired.

The *Contractor* is required to supply and erect appropriate protection barriers/shrouding or other approved means as required in the cooling tower so as to completely contain all loose or flying debris from the surface preparations. The means of containment shall be subject to the approval of the *Employer*.

All areas of unsound concrete to be repaired will be marked by the Engineer once the Contractor has cleaned the existing surface. The Contractor is required to saw cut the outer perimeter of the repair areas as directed by the Engineer. The Contractor is required to ensure that the existing reinforcing steel is not damaged during saw cutting. Any damage caused by the Contractor to any portion of the structure not intended for repair shall be repaired by the Contractor, at the Contractor's expense, to the satisfaction of the Employer.

The Contractor is required to remove all areas of unsound concrete by chipping or other approved methods. The Contractor shall exercise caution and take care not to damage any existing reinforcing steel intended to remain in place.

<u>Surface preparation steps:</u>

a. Prepare the substrate by cutting a square perimeter around the affected area, chipping down a minimum of 50mm behind the exposed circumferential reinforcing and remove all loose material.
b. If the corrosion of the beams reinforcing is only superficial, then the square cut-out, as described above, is complete.
c. If the exposed reinforcing is pitted, then the cut-out, as described above, must be continued around the perimeter of the beam to expose the extremities of the corroded reinforcement bar.

6.2 PLACEMENT AND FINISHING OF REPAIR MORTAR

The concrete repair mortar shall be handled, stored, mixed and applied in accordance with the manufacturer's instructions.

The *Contractor* is required to place the repair mortar such that the existing profile and cross section are restored to their original dimensions. Any deviations of the repaired areas to the existing surface shall be repaired by the *Contractor* at his expense to the satisfaction of the Employer.

If the existing or repair concrete surface is damaged in any way by construction operations, or if the concrete repair shows signs of distress or scaling prior to final acceptance, it shall be repaired or replaced by the *Contractor* at his own expense.

6.3 TYPES OF REPAIR

Concrete repairs will be classified as follows:

6.3.1 Type X repair

Type A repair is defined as removal of unsound concrete to a depth not greater than the top of the existing reinforcing steel prior to concrete repair. The *Contractor* is required to remove all unsound concrete from the areas to be repaired until a sound concrete substrate is exposed.

6.3.2 Type Y repair

Type B is defined as removal of unsound concrete to a depth beyond the existing reinforcing steel prior to concrete repair.

[A detailed concrete repair method should be provided by the contractor]

7. METHOD OF MEASUREMENT

Concrete repairs will be measured on a volumes basis. The area to be paid for will be the total number of square metres of concrete repaired in accordance with this specification as computed from measurements made by the Engineer.

8. BASIS OF PAYMENT

Concrete repairs will be paid for at the Contract Unit Price per cubic meter for concrete repairs measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work. Refer to appendix for a guideline for cost breakdown per item.

9. INFORMATION ISSUED BY THE EMPLOYER

The following drawings and standards are issued to the *Contractor* for information.

Document number	Document Title	Revision
240-107981296	Constructability Assessment Guideline	1

10. APPENDIX A: DEFECTS

Provided below is a summary of important findings from the structural investigation.

Photo 1: Failed precast concrete corbel

Photo 2: Evidence of concrete scaling between the beam and column

Photo 3: Concrete corbel spalling

Photo 4: Rusted stainless steel knee-bracing -type A

Photo 5: Rusted stainless steel knee-bracing - type B

Photo 6: Cracked concrete corbel

Photo 7: Scaling and corrosion on the concrete channel

11. APPENDIX B: DRAWINGS