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Authorization

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This document has been revised according to the following schedule:

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Contents:

1.0 INTRODUCTION

The Nuclear Energy Corporation of South Africa (Necsa) requires practical and on-the-job training for personnel who will be responsible for operating the Coreless Induction Furnace and associated equipment at the Smelter Plant.

The purpose of this Scope of Work (SOW) is to define the requirements for the appointment of a suitably qualified and experienced training service provider to conduct practical and on-the-job training for furnace operators. The training will be conducted at the Necsa Smelter Plant in Area 26 and will focus on the safe and effective operation of the 125 kg/100 kW Coreless Induction Furnace,2 x 4tons induction furnaces and its associated plant subsystems.

The training is intended to provide operators with practical, hands-on experience in operating the furnace and associated equipment under normal operating conditions. The training will also develop the operators' ability to perform pre-operational checks, start up and shut down the plant, monitor operating parameters, conduct melting and casting activities, identify abnormal operating conditions, respond to emergencies, and perform basic operational troubleshooting.

The practical training will cover the integrated operation of the furnaces and relevant supporting systems, including the power supply, cooling water systems, emergency cooling water system, off-gas system, furnace refractory lining, charge material preparation, casting system, ladle handling, sampling and de-slagging activities.

The training service provider shall develop and implement a structured practical training programme that combines supervised hands-on training, demonstrations, operational exercises and competency assessments. The training shall be aligned with Necsa's approved operating procedures, safety requirements and applicable regulatory requirements.

The objective is to ensure that furnace operators acquire the necessary practical knowledge, skills and demonstrated competence to safely operate the Coreless Induction Furnace and associated equipment and to respond appropriately to normal, abnormal and emergency operating conditions.

2.0 OBJECTIVES

The objectives of the practical and on-the-job training are to:

- Develop the practical skills required to safely operate the 125 kg/100 kW Coreless Induction Furnac,2 x 4tons induction furnaces and associated plant equipment.
- Provide operators with hands-on experience in furnace preparation, start-up, operation, melting, temperature monitoring, tapping/casting and shutdown.

- Develop operator competence in monitoring and controlling key furnace and process parameters during operation.
- Train operators to perform pre-operational, operational and post-operational inspections.
- Develop the ability to identify abnormal operating conditions and take appropriate corrective actions in accordance with approved operating procedures.
- Provide practical training in the operation and monitoring of the furnace auxiliary systems relevant to furnace operation.
- Develop operator competence in responding to operational emergencies and implementing emergency shutdown procedures.
- Provide practical exposure to furnace refractory lining inspection, condition monitoring and identification of potential refractory-related problems.
- Develop operator skills in basic operational troubleshooting and the identification of equipment faults requiring maintenance intervention.
- Ensure that operators understand and consistently apply applicable safety, environmental and radiological protection requirements during smelter operations.
- Assess the practical competency of each operator following completion of the training.
- Provide Necsa with documented evidence of training, assessment results and operator competency.

3.0 SCOPE OF ON-THE JOB TRAINING

The practical and on-the-job training shall be conducted at the Necsa Smelter Plant in Area 26 using the applicable plant equipment and systems.

The scope of training shall focus on the practical activities that furnace operators are required to perform to safely operate the furnace and associated plant systems.

The training service provider shall ensure that the training programme provides sufficient practical exposure for operators to perform, under appropriate supervision, the activities relevant to their operational responsibilities.

The scope of practical training shall include, but not be limited to:

- Coreless induction furnace operation.
- Furnace preparation and pre-operational inspections.
- Furnace charge material preparation, selection and loading.
- Furnace lining and refractory condition monitoring.
- Furnace start-up and shutdown.
- Sintering of the furnace refractory lining.
- Melting operations and process control.

- Monitoring and recording of operating parameters.
- Molten metal temperature measurement.
- Furnace tapping and casting.
- Slag management and de-slagging.
- Sampling and sample preparation.
- Operation and monitoring of cooling water systems.
- Operation and monitoring of the emergency cooling water system.
- Operation and monitoring of the off-gas system.
- Operation of relevant auxiliary systems.
- Identification of abnormal operating conditions.
- Basic operational troubleshooting.
- Emergency start and stop procedures.
- Response to furnace and plant emergencies.
- Safe handling of molten metal.
- Production data recording and reporting.
- Plant housekeeping.
- Application of approved SOPs and operational procedures.
- Basic operational maintenance activities within the operator's authorised responsibilities.

The service provider shall clearly identify in the training programme which activities will be covered through demonstrations, supervised practical exercises and individual competency assessments.

3.1 Coreless Induction Furnace– Practical Training

The training service provider shall provide practical, hands-on training to operators on the operation and monitoring of the Coreless Induction Furnace.

The training shall be conducted using the actual furnace and associated equipment, where operationally and safely practicable.

The practical training shall include, but not be limited to, the following:

- Conducting pre-start inspections of the furnace and associated equipment.
- Operating and monitoring the furnace cooling water system.
- Identifying abnormal cooling water conditions and taking appropriate first-line actions.
- Operating and monitoring relevant auxiliary systems required for safe furnace operation.
- Performing slag removal and de-slagging activities safely.
- Conducting molten metal tapping and casting activities under appropriate supervision.

- Performing sampling activities and preparing samples in accordance with approved procedures.
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- Performing furnace shutdown activities.
- Conducting post-operation inspections and housekeeping.
- Demonstrating the correct response to abnormal operating conditions.
- Demonstrating the correct implementation of emergency stops and shutdown procedures.
- Identifying common operational problems and taking appropriate first-line actions in accordance with approved procedures.
- Correctly escalating equipment faults and abnormal conditions to the supervisor responsible or maintenance personnel.
- Demonstrating safe operating practices throughout all practical activities.

The training provider shall ensure that each operator receives sufficient hands-on exposure and supervised practice to demonstrate competence in the practical activities applicable to their assigned operational responsibilities.

The training provider should maintain individual training and competency records for each operator, documenting the practical activities completed, level of participation, assessment results and areas requiring further development.

3.2 Furnace Operation and Process Control

The practical training shall include the following furnace operation and process control activities:

- Performing pre-operational checks before starting the plant.
- Preparing the furnace and associated equipment for operation.
- Following the correct sequence for starting the furnace and associated plant systems.
- Charging the furnace with approved charge materials.
- Monitoring furnace operation throughout the melting cycle.
- Monitoring and recording furnace operating parameters.
- Measuring molten metal temperature at the required stages of the process.
- Monitoring furnace power and other relevant process parameters.
- Identifying abnormal process conditions and initiating appropriate corrective actions.
- Monitoring furnace lining condition and identifying potential refractory failures.
- Operating and monitoring the cooling water system.
- Operating and monitoring the emergency cooling water system.
- Operating and monitoring the off-gas system.
- Performing slag management and de-slagging.

- Conducting tapping and casting operations.
- Taking representative samples and performing sample preparation.
- Completing production records and operational log sheets.
- Analysing operational data and identifying trends or abnormal conditions.
- Performing plant shutdown in accordance with approved procedures.
- Conducting post-operational inspections.
- Performing emergency start and stop procedures.
- Maintaining good housekeeping standards.
- Applying approved SOPs and work instructions during plant operation.

3.3 Safety Procedures and Compliances

The practical training shall ensure that operators are able to apply relevant safety requirements during all furnace operating activities.

The training shall include practical application of:

- Pre-task risk assessments and job hazard analysis.
- Pre-task safety discussions and toolbox talks.
- Tag-in/tag-out procedures and applicable isolation requirements.
- Job card systems and required authorisations.
- PPE and PPC requirements.
- Safe handling of molten metal.
- Safe furnace charging, tapping and casting practices.
- Electrical safety requirements.
- Arc flash hazard awareness and prevention.
- Safe working practices around high electrical energy.
- Safe working with cooling water systems.
- Safe working with compressed air systems.
- Safe working with off-gas systems.
- Fire prevention and emergency response.
- Response to furnace-related emergencies.
- Response to cooling water failures.
- Response to loss of electrical power.
- Response to off-gas or ventilation failures.
- Response to refractory failure and potential furnace run-out conditions.
- Applicable environmental requirements.
- Applicable radiological safety requirements.
- Hazard identification and risk assessment.
- Reporting of incidents, near misses and unsafe conditions.
- Emergency evacuation and emergency communication procedures.

- Compliance with applicable necsa safety procedures and workplace requirements.

3.4 MAINTENANCE AND TROUBLESHOOTING

The training shall provide operators with practical knowledge and skills to identify operational problems and perform basic troubleshooting within the limits of their authorised responsibilities.
The training shall include**:**

- Routine operational inspections.
- Identification of abnormal equipment conditions.
- Identification of common furnace operational problems.
- Identification of potential coil-related failures.
- Identification of refractory wear and deterioration.
- Identification of potential cooling water leaks or failures.
- Identification of abnormal cooling water conditions.
- Identification of off-gas system problems.
- Identification of abnormal electrical and instrumentation conditions.
- Basic troubleshooting of furnace auxiliary systems.
- Appropriate first-line corrective actions.
- Safe isolation and escalation of equipment faults.
- Reporting equipment defects to maintenance personnel.
- Identification of critical equipment spares.
- Understanding the purpose and application of critical spares.
- Contribution to the identification and compilation of a critical spares list.

Operators shall not be trained or authorised to perform maintenance activities outside their defined roles, competencies and approved work procedures.

4.0 TRAINING METHODOLOGY

The training service provider shall propose a training methodology that prioritises practical, hands-on learning and operator competency development.

The methodology shall include, as a minimum:

- Practical hands-on training using actual plant equipment where operationally and safely practicable.
- Trainer demonstrations followed by supervised operator practice.
- Individual operator participation in practical activities.
- On-the-job coaching by suitably qualified and experienced trainers.
- Practical exercises covering normal operating conditions.

- Practical exercises covering abnormal operating conditions.
- Practical emergency response exercises, where safe and practicable.
- Group discussions and problem-solving exercises.
- Review and application of relevant necsa sops and work instructions.
- Practical troubleshooting exercises.
- Individual competency assessments.
- Documentation of practical activities completed by each operator.
- Identification of individual competency gaps.
- Additional coaching or reassessment where an operator does not initially demonstrate the required competence.

The training provider shall prepare a detailed training plan and methodology for review and approval by Necsa before commencement of training.

The training provider shall prepare an individual operator training and competency portfolio for each participant.

The training provider shall ensure that theoretical instruction, where required, directly supports the practical training activities and is not used as a substitute for required hands-on training

5.0 TRAINING DURATION AND SCHEDULE

The training service provider shall propose a detailed training duration and schedule based on the requirements of this Scope of Work and the competency requirements of the furnace operators.
The proposed training programme shall clearly define:

- The overall duration of the training;
- The number and duration of training sessions;
- The balance between theoretical instruction, demonstrations and practical hands-on training;
- The sequence of practical training activities;
- The number of operators to be trained in each session;
- The equipment and systems to be covered;
- The competency assessment activities; and
- The proposed completion date.

The training schedule shall be submitted to Necsa for review and approval prior to commencement of the training.

The training provider shall ensure that sufficient practical exposure is provided for each operator to demonstrate competence in the required operational activities.

6.0 PARTICIPANTS

The training is intended for furnace operators who will be involved in the operation of the Coreless Induction Furnace and associated plant systems.

The anticipated number of participants shall be communicated to the training provider by Necsa.

The training provider shall recommend an appropriate number of participants per practical training group to ensure that each operator receives adequate hands-on exposure and individual assessment.

The final number of participants and grouping arrangements shall be agreed between Necsa and the training provider before commencement of training

7.0 DELIVERABLES

The training service provider shall provide the following deliverables:

7.1 TRAINING PLAN AND PROGRAMME

A detailed training plan and programme, including:

- Training objectives.
- Training methodology.
- Training content.
- Practical activities.
- Training schedule.
- Equipment and systems to be covered.
- Practical training arrangements.
- Competency assessment methodology.
- Trainer details and qualifications.

7.2 TRAINING MATERIALS

Training materials relevant to the practical training, including, as applicable:

- Training manuals.
- Training presentations.

- Practical training guides.
- Handouts.
- Checklists.
- Practical assessment tools.
- Relevant training exercises.

All training materials shall be submitted to Necsa for review and approval where required.

7.3 Practical Training

The service provider shall provide supervised practical and hands-on training for all nominated operators in accordance with the approved training programme.

7.4 Operator Competency Assessment

The service provider shall conduct an individual competency assessment for each operator.

7.5 Individual Competency Portfolio

- Training attendance records.
- Practical activities completed.
- Assessment records.
- Competency assessment results.
- Identified competency gaps.
- The assessment shall include practical demonstration of the operator's ability to perform the applicable operational tasks safely and effectively.
- Corrective or additional training provided.
- Final competency status

The service provider shall compile an individual competency portfolio for each operator containing, as applicable

7.6 Training Attendance Records

Approved attendance records for all training sessions shall be submitted to necsa.

7.7 COMPETENCY CERTIFICATES

Competency certificates shall be issued to operators who successfully meet the required competency standards.

The competency certificate shall clearly indicate the scope of competence assessed.

7.8 FINAL TRAINING REPORT

A final training report shall be submitted to Necsa upon completion of the training.

The report shall include:

- Summary of training activities conducted.
- Training dates and attendance.
- Operators trained.
- Practical activities completed.
- Competency assessment results.
- Individual operator competency status.
- Identified competency gaps.
- Additional training or reassessment undertaken.
- Key observations.
- Recommendations for further training or development.
- Conclusion on overall training effectiveness.

7.9 TRAINER QUALIFICATIONS

The training service provider shall provide suitably qualified and experienced trainers with demonstrated competence in induction furnace and smelter operations.

The trainers shall, as a minimum, have:

- Extensive practical experience in Coreless Induction Furnace operations.
- Demonstrable experience in practical and on-the-job operator training.
- Knowledge and practical understanding of metallurgy and furnace chemistry.
- Practical knowledge of furnace electrical systems and controls.
- Practical knowledge of instrumentation and process monitoring.
- Knowledge of mechanical systems associated with induction furnaces.
- Experience in furnace maintenance and operational troubleshooting.
- Experience in furnace refractory and lining condition monitoring.
- Experience in furnace safety and emergency response.
- Experience in competency-based operator assessment.
- Relevant industrial training experience.

Trainers with appropriate professional certifications and relevant registration with recognised training authorities, including Merseta where applicable, shall be preferred. The service provider shall submit trainer CVs and evidence of relevant qualifications, experience and competency for Necsa's review before commencement of training.

8.0 TRAINING EVALUATION AND FEEDBACK

The effectiveness of the training shall be evaluated through practical competency assessments and participant feedback.
The training provider shall:

- Conduct individual practical competency assessments.
- Evaluate each operator against defined competency criteria.
- Document assessment results.
- Identify competency gaps.
- Provide additional coaching or training where required.
- Conduct reassessments where necessary.
- Obtain feedback from participants.
- Evaluate the effectiveness of the training methodology.
- Submit a final training report to Necsa.

Training shall not be considered successfully completed solely based on attendance. Each operator shall demonstrate the required level of practical competence in the activities applicable to their operational responsibilities.

9.0 RESPONSIBILITIES

9.1 TRAINING SERVICE PROVIDER

The training service provider shall:

- Develop and submit the training plan and schedule.
- Provide suitably qualified and experienced trainers.
- Conduct the approved practical and on-the-job training.
- Provide training materials and assessment tools.
- Ensure that practical training is conducted safely.
- Assess the competency of individual operators.
- Maintain accurate training and assessment records.
- Provide competency certificates to operators who meet the required competency standards.

- Submit the final training report.
- Identify and communicate competency gaps.
- Recommend additional training where required.

9.2 NECSA

Necsa shall:

- Provide access to the relevant plant and equipment, subject to operational availability and safety requirements.
- Provide applicable approved SOPs and relevant operational procedures.
- Provide site-specific safety and induction requirements.
- Facilitate access to relevant plant areas.
- Nominate operators for training.
- Facilitate participant availability.
- Provide required PPE/PPC in accordance with Necsa requirements.
- Review and approve the training plan and schedule.
- Review training materials where required.
- Monitor the delivery of the training.
- Review training and competency records.
- Facilitate access to relevant equipment and systems required for practical training, where available and safe to operate.

9.3 PARTICIPANTS

Participants shall:

- Attend all scheduled training activities.
- Actively participate in theoretical and practical training.
- Follow all Necsa safety and operational requirements.
- Use the required PPE/PPC. Perform practical activities only under the level of supervision authorised by the trainer.
- Participate in competency assessments.
- Report unsafe conditions and operational concerns.
- Demonstrate the required level of competence before being authorised to independently perform applicable operational tasks.