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1633

April 1987

English

PREPARATION OF DETAILED DESIGN  
FOR THE ESTABLISHMENT OF A DEMONSTRATION  
INVESTMENT FOUNDRY WITH AUXILIARY  
DEMONSTRATION PLANT FOR THE MANUFACTURE  
OF WAX INJECTION DIES FOR THE PRODUCTION  
OF REPLICAS  
UT/RAF/85/200

FINAL REPORT

255

Based on the work of TESCO-UVATERV Consulting-Engineering  
Company  
Budapest - Hungary

United Nations Industrial Development Organization

This study has not been cleared with the United Nations Industrial Development Organization, which does not therefore, necessarily share the views presented.

## INTRODUCTION

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The UNIDO in co-operation with other international organizations promotes and supports the African Regional Centre for Engineering, Design and Manufacturing /ARCEDEM/ located in Ibadan, Nigeria.

In the framework of the Industrial Development Decade for Africa the Hungarian Government provided a considerable pledge for the purposes of the Decade.

Based upon the request of ARCEDEM UNIDO assigned TESCO-UVATERV Consulting Engineering Company to prepare and deliver technical documentation for the establishment of an investment casting pilot plant for training and demonstration purposes. The project has been financed from the Hungarian Government contribution to the IDDA.

## THE WORK PERFORMED

The project has been implemented in accordance with the Substantive Terms of Reference dated 21 November 1985 attached as Annex 1.

The following technical documents have been submitted to UNIDO:

- detailed lay-out of the proposed plant
- list of machinery
- energy supply network
- detailed documentation of five machines of the machine-line for local manufacturing
- detailed documentation of ten different, commonly selected precision castings wax dies
- detailed know-how of the precision casting technology

The detailed list of drawings and documentation submitted is attached as Annex 2.

## RECOMMENDATION

In order to widely introduce the investment casting technology in the African developing countries it is highly recommended to establish the investment foundry demonstration unit at the premises of ARCEDEM in Ibadan, Nigeria.

TERMS OF REFERENCE

**PROJECT:** UT/UC/RAF/85/200 - "Preparation of Detailed Design for the Establishment of a Demonstration Investment Foundry, with Auxiliary Demonstration Plant for the Manufacture of Wax Injection dies for the Product of Replicas."

1. BACKGROUND

The Investment Casting Process, also known as the "lost wax" casting method, is a process which has existed for many thousand of years, and has been and is used to reproduce parts to a high degree of accuracy, detail, and with a fine surface finish. The technical advantages of the process are such that due to the accuracy of the process, and the surface quality, such finishing processes as machining or polishing may frequently be dispensed with, or reduced considerably. This results in a notable reduction in the requirement for machine tools, and for trained machine tool operators.

The investment casting process is used for producing a range of products which can vary from simple hand tools to highly sophisticated machine parts, and in the case of hand tools the parts may merely require assembly, following a simple cleaning operation.

The operation of the plant is in the hands of unskilled and semi-skilled labour, only the melting furnace operator requires a high degree of training. The manufacture of the dies used for the production of the wax patterns is a skilled trade, but much less exigent than normal toolmaking. Moulds for short production runs may be cast using low melting point alloys, at very low cost and can be in production in a few days, and the dies required for longer production runs, and for more sophisticated parts, may be cast using ceramic mould precision casting system. This allows a very rapid, low cost production of dies of which a not inconsiderable number are required before the investment casting production may commence.

The great importance of die manufacture is recognized by inclusion of specific activities to establish a separate plant which will also serve by producing dies for other plants, and for training purposes.

This project is a first phase activity, for the preparation of detailed project designs which will cover buildings, detailed layout drawings, and all equipment which may be reasonably considered for local manufacture. Designs for the wax injection dies for the more obvious, universally consumed products will be supplied. These project designs will be the property of UNIDO and will be of universal application. It is hoped that the second phase activities, which will include installation and "start up" of a demonstration plant, will be implemented at ARCEDEM (African Regional Centre for Design and Manufacturing) installations at Ibadan in Nigeria. The existence of these designs and the experience obtained at ARCEDEM will considerably reduce the cost of subsequent installations.

OUTPUTS

The outputs will be:

1. Detailed modular plant layout. The different activities will be developed as independently as possible in order to obtain the maximum flexibility of application. Layouts will include all services.
2. Equipment specifications.
3. Detailed engineering drawings and construction details/instructions of equipment which may be considered for local construction, such as equipment for:
  - a. Wax mixing
  - b. Wax injection
  - c. Fluidized bed coating tanks
  - d. Transport of green shells
  - e. Burn out furnace
4. Wax injection die designs.
5. Detailed training programme for all professional, skilled and semi-skilled posts, and those unskilled posts which require preparation.

NOTE:

1. The subcontractor will discuss with UNIDO, the equipment specifications and UNIDO will hold the final decision as to what equipment should be considered for local construction, and thus which detailed drawings etc., shall be prepared.

Such drawings etc., as may be produced will be examined with a UNIDO staff member in Vienna, in order to ensure that they are complete. UNIDO may request such additions or modifications as are considered necessary.

2. Wax injection die designs will be prepared for a number of universally consumed articles/tools, offering a production volume of some 50 tpa within a developing economy in accordance with the experience of the subcontractor.
3. Refractory formulations will be supplied.
4. Operational instructions will be supplied for equipment specifically limited to investment foundry (this excludes such items as furnace operation, shot or sand blast cleaning which are universal to foundry operation).

3. DELIVERY

The final papers will be delivered to UNIDO not later than three months following the award of the contract.

4. REVISIONS

During the three months following the award of the contract, those engineers working on the project will visit UNIDO Headquarters for consultations concerning the work in hand. The objective is to obtain the documents in an accepted final form upon conclusion of the contract. The timetable for such consultations will be agreed between the subcontractor and the UNIDO backstopping officer.

5. TERMS OF PAYMENT

25% on award of contract

25% 6 weeks following award

25% on delivery of finalized documents

25% on final approval by UNIDO

LIST OF DRAWINGS , MANUALS AND  
KNOW-HOW DELIVERED BY TESCO/UVATERV  
IN THE FRAMEWORK OF UNIDO PROJECT  
NO. UT/RAF/85/200

Identification No. of materials	Denomination of the materials	No of copies delivered
1875	List of equipment specification	5
T100/5-16813	Technological lay-out	5
A/5-16533	Wax mixing device	5
D/5-16659	Wax injection	5
E/1560	Fluidizing bed coating tank	5
F/S-16449	Mixing-dipping tank	5
SZ/K-21	Transport of green shells	5
KC080/50-120	Burn-out electric furnace - manual on product	5
163188	Know-how of the technology Detailed drawing on wax cocillas of:	5
5.01-01	- hammer	5
5.02-01	- rotating holder	5
5.03-01	- tap wrench	5
5.04-01	- cutting pliers /moving pat/	5
5.05-01	- cutting pliers /stable pat/	5
5.06-01	- gripp pliers /moving pat/	5
5.07-01	- gripp pliers/stabb	5



5.08-01	- oil filter wrench	5
5.09-01	- water pump pliers/moving part/	5
5.10-01	- water pump pliers/stable part/	5