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U N I D O – Vienna – AUSTRIA
General Services Branch,
Purchase & Contracts Section
Administrative & Financial Control
Field Operations & Administration Division

FINAL REPORT

Project No. MP/LEB/97/084

Contract No. 98/247/VK

Phasing-out CFC's at Lebanese Modern
Industrial & Trading Co., Lebanon

**PLEASE BE AWARE THAT
ALL OF THE MISSING PAGES IN THIS DOCUMENT
WERE ORIGINALLY BLANK**

LEMATIC

THERMOTECHNIK HANDELS GMBH

LEMATIC Thermotechnik Handels GmbH - Berliner Allee 40 - D-40212 Düsseldorf.

United Nations Industrial Development
Organization (UNIDO)
General Services Branch,
Purchase and Contracts Section,
Administrative and Financial Control
Field Operations & Administration Division
P.O.Box 300 – A-1400 Vienna
Fax: 43-1-26026-6816
AUSTRIA
Att: Mr. V. KOLOSKOV

LEMATIC Thermotechnik Handels GmbH
Berliner Allee 40
D-40212 Düsseldorf
Telefon 0211 – 327941
Telefax 0211 - 327968

Kto.-Nr. 1358720 Commerzbank Düsseldorf (BLZ 300 400 00)
HRB 17419 Amtsgericht Düsseldorf,

Düsseldorf, Feb. 7th, 2001

Ref: - Contract No. 98/247/VK
- Project No. MP/LEB/97/084
- Phasing-out CFC's at Lebanese Modern Industrial & Trading Co./Lebanon
- Final Report – para 3.22 g)

Dear Sir,

In accordance to the instructions cited in the above-mentioned contract given to the contractor for the dispatch of Progress reports covering the work performed to finalize the project no. MP/LEB/97/084, we would like to enclose the requested final report in English language in ten (10) copies.

In reference to your fax dated Feb. 2001, we are enclosing 10 copies of each of the two TÜV separate safety certificates issued for each factory. Accordingly, please arrange to settle our invoice no. UNI/A-L 99100/9 (enclosed - amounting to USD 29,000.00 - dated Dec.22.1999.

Thanking you in advance for your kind attention, we remain,

Sincerely Yours,
LEMATIC THERMOTECHNIK Handels GmbH


Talal Kreidieh
Project Team Leader

Encl.

FINAL REPORT

Reference:- Contract No. 98/247/VK

- Project No. MP/LEB/97/084
- Phasing-out CFC's at Lebanese Modern Industrial & Trading Co./Lebanon
- Final report – Para 3.22 g)

In accordance to the above-mentioned contract, we are glad to confirm finalizing project no. MP/LEB/97/084 for phasing-out CFC's at Lebanese Modern Industrial and Trading Co. in Lebanon that consists of two factories for the production of domestic refrigerators, cooler, and freezers.

We confirm finalizing all our obligations stated in the Terms of Reference, we hereby summarize the finalized steps:

Supply of technical documentation to guide the counterpart personnel about the CFC-free material, components and new equipment and machinery as well as the difference between old CFC and new CFC-free substances.

Supply of technical documentation about the necessary modifications in the production layouts to show new distributions of some machines as well as the positioning of new machinery and systems.

Supply of technical documentation to guide the counterpart personnel about the necessary services and works that they should provide according to Terms of Reference prior to the installation of new equipment and machinery.

Delivery of all equipment, machinery and systems according to Terms of Reference.

Modifications of some of the existing moulds, fixtures, plugs and profiles as per Terms of Reference.

Replacement, retrofitting/rebuilding, cleaning, refilling and maintenance of existing production equipment, utilities and testing/ servicing equipment as per Terms of Reference.

Coordinating with the counterpart to prepare Cyclopentane storage tank area. Anyhow, the counterpart decided to move the Cyclopentane storage tank further outside the plant site to secure more safety. We supported this step. Counterpart financed all additional works regarding this step.

Installation of all equipment, machinery and systems at both factories, commissioning and testing of all installed and converted systems.

Cooperation with counterpart personnel in redesigning of refrigeration systems and in the structure of refrigerators, coolers, and freezers to enable these products to work with CFC-free material. As well as training appointed personnel to continue practical future redesigning. After redesigning, prototypes were produced before considering the final production.

Supplying the counterpart detailed component lists for the proper items and components of their products that will be the most suitable to be used with CFC-free material.

Training of technical, operational and supervising (including industrial safety) personnel. Supplying the counterpart a full set of warning instructions to be followed and set of warning signs to be put inside the plant sites in the hazard areas to ensure that all safety regulations are followed, in addition to a periodical plans for checking and maintenance of installed systems.

Assisting the counterpart to obtain legal certificates from local authorities in Lebanon.

The counterpart finalized all services and works that are listed in the Terms of Reference according to our specification.

In spite of the delay that was caused by unexpected circumstances and related to the counterpart, he arranged to carry out other additional works that were not considered in Terms of Reference. The counterpart arranged under his own cost to move the location of cyclopentane tank further outside the plant site, also moved complete production line to the same building with the other production line to ensure the easiness and safety of the delivery and transferring hazardous material and equipment to both production

plants. Counterpart carried out the civil, mechanical and electrical constructions and works for the above.

Anyhow, we have instructed the counterpart to achieve additional civil, mechanical and electrical works to furnish the new location of cyclopentane tank and the new moved production line with necessary industrial requirements.

Our team have put new conception of the new layout of the plants for Concord and Opaco factories after changing initial places of some machines to fit new conception especially in the foaming machines and the Cyclopentane tank areas.

Even that all equipments and systems were installed and all related works were done according to the Terms of reference, we noted the following points at the converted plants:

- The Nitrogen generator was not sufficient for the total production capacity of both factories,
- Another complete mix-head with related adjustments should be added to the installed PU Hennecke machine as one mix-head was not sufficient too,
- Counterpart lab. couldn't continue the redesigning of all models due to the lack of automatic charging board,

However we informed the counterpart about above points and recommended the following additional equipment (our letter dated May 28, 1999):

- 2 units, helium charging, testing and recovery unit, such unit are used in most of refrigerator factories to check any leakage of cooling units at production lines.

Manufacturers: Galileo – Italy / Model ASTRA A/TS

A'Gramkow – Denmark / model HRS6-1 + PROTEC + TL4.6

Optional: 2 units, nitrogen charging, testing and recovery unit.

- 1 unit, ratio output controller for the installed Hennecke PUR high-pressure foaming machine model HK650 P/ML, this controller will control the quantities and ratios of isocyanate and polyol/Cyclopentane before flowing to mix-head.
- 2 units, Polyol day tank to prevent interruption of production.
- 2 units, flow testing unit, to check blocking inside refrigeration unit tubes caused by oil or other materials.

- 2 units, high efficiency production leaks detectors (Halogen type) for HFC-134a similar to the two units that already supplied to counterpart according to TOR. UNIDO's contract covered two units, which we consider is not enough for the production capacity at counterpart factories.

Manufacturer: Leybold / model: HLD 400A

- 20 units, Halogen handheld leaks detectors for HFC-134a, low accuracy similar to the two units that already supplied to counterpart according to TOR. UNIDO's contract covered two units, which we consider is not enough for the production capacity at counterpart factories.
- Other advises have been passed to the counterpart to provide additional equipment such as:
 - Performance test apparatus,
 - Safety arrangements on the roller conveyor,

The results of the new CFC free production was acceptable to the counterpart and without any problem expect that we recommend having the additional equipment mentioned above.

We have been contacting TÜV – Germany during all phases of the conversion process. We have consulting them about most of the items that were involved in the installation and conversion of machinery, equipment, systems and even for using small items in the hazardous areas.

TÜV had a full cooperation with our company from the beginning of this project. Accordingly TÜV issued the attached two separate certificates for each factory.

We hope that above mentioned report will be satisfactory and meets your needs.

Should you require any further explanation, please do not hesitate to contact us and we are always at your disposal.

Thanking you in advance for your kind assistance and cooperation, we remain,

Yours faithfully

Lematic Thermotechnik Handels-GmbH



Talal Kreidieh

Project Team Leader

CERTIFICATE

No.: TÜV- BB-UL 984 228 900

This is to certify that

Subject: Pentane-PU Foaming System
Refrigerator & Freezer Factory

Producer: LEMATIC Thermotechnik
Handels GmbH

Operated: LEBANESE MODERN INDUSTRIAL
AND TRADING CO.
CONCORD factory
Naameh / Lebanon

meets the requirements of the TÜV Süddeutschland BB-ULM.
It was installed according to the relevant International Standards.
The Pentane PU foaming system has been submitted to an audit
to verify compliance with the state of the art.
The system was audited finally in the period
from 20th to 22nd November 2001.

This Certification is based on Report
on Technical Plant Inspection and
Evaluation of Final Report
TÜV BB-ULM-Ri/Ma
File No.: C5/Lem-LEB/03/01

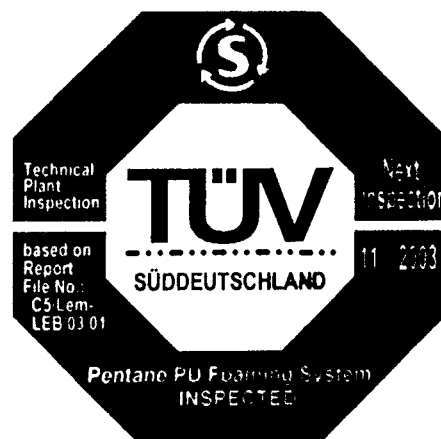
This Certification is valid until
November 2003

Ulm, 18 January 2001
TÜV Süddeutschland experts

K.-J. Richardt

E. Mack

TÜV Süddeutschland Bau und Betrieb GmbH Niederlassung Ulm Benzstrasse 17 D-89079 Ulm
Tel. +49 (731) 49 15-2 30 Fax +49 (731) 49 15-3 60



CERTIFICATE

No.: TÜV- BB-UL 984 228 900

This is to certify that

**Subject: Pentane-PU Foaming System
Refrigerator & Freezer Factory**

**Producer: LEMATIC Thermotechnik
Handels GmbH**

**Operated: LEBANESE MODERN INDUSTRIAL
AND TRADING CO.
OPACO factory
Naameh / Lebanon**

meets the requirements of the TÜV Süddeutschland BB-ULM.
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TÜV Süddeutschland Bau und Betrieb GmbH Niederlassung Ulm Benzstrasse 17 D-89079 Ulm
Tel. +49 (731) 49 15-2 30 Fax +49 (731) 49 15-3 60



TÜV Bau und Betrieb · Benzstraße 17 · D-89079 Ulm

Lematic LTD.
Mr. Kreidieh
Verdung Street

RL-Beirut

**Bau und
Betrieb**

Your reference/letter of

Our reference/name
BB-NDD-ULM/Ri-se
Karl-Josef Richardt

Phone/Fax
2 30 // 3 60

Date
2001-01-22

Niederlassung Ulm

Benzstraße 17
D-89079 Ulm
Phone (07 31) 49 15-2 28
Fax (07 31) 49 15-3 60
www.tuevs.de
E-mail Karl-Josef.Richardt
@tuevs.de

Dear Mr. Kreidieh,

Enclosed we are sending you: Copy Report
6 Certificates (3 Concorde, 3 OPACO)

☐ returned with thanks

☐ as per your letter

Date: _____

☐ as per our letter

Date: _____

☒ for your files

☐ as agreed by phone

Date: _____

with: _____

TÜV Süddeutschland
Bau und Betrieb GmbH
Aufsichtsratsvorsitzender:
Karsten Puell
Geschäftsführer:
Roland Ayx (Sprecher)
Dr. Kurt Vinzens
Sitz: München
Amtsgericht München
HRB 96 869

with a request:

☐ for further processing

☐ for your comments

☐ to be taken note of

☐ for a return call

☐ for an appointment

☐ for return to us

Short message: _____

Best regards

K. A. Ayx



DAP-P-02.772.03-98-00
DAP-P-02.885.01-93-01
DAP-P-02.886.00-94-01
DAP-P-03.089.00-96-01

Test laboratories accredited by
the DAP Deutsches
Akkreditierungssystem
Prüfwesen GmbH (German
accreditation body for testing
organizations)

Dokument4



Plant Location:	The Lebanese Modern Industrial and Trading Co. Concord and Opaco factory Naámeh, near Beirut Lebanon
Plants:	<ul style="list-style-type: none">- C5 Storage area- Plant 2nd floor<ul style="list-style-type: none">• C5 Storage area• Pre-mix / Dosing unit• Dry part- Plant 3rd floor<ul style="list-style-type: none">• Pre-mix / Dosing unit• Dry part
Manufacturer of the plants:	1. Lematic Thermotechnik Handels GmbH 2. Hennecke company/Germany (supplier of the plants)
Project:	Conversion of the Freezer and Refrigerator Plants with Pentane as blowing agent
UNIDO-Project	MP/LEB/97/084
TÜV-ORDER No.:	984 228 900
TÜV-Experts:	Karl-Josef Richardt - TÜV-BB-UL, Dep. NDD Eberhard Mack - TÜV-BB-UL, Dep. NEG Company Group TÜV Süddeutschland
Data:	<ul style="list-style-type: none">- 16th May 2000<ul style="list-style-type: none">• Pre-Inspection of the plants- 14th August 2000<ul style="list-style-type: none">• Preparation of Report (No.1)- 20th to 22nd November 2000<ul style="list-style-type: none">• Inspection of Concord and Opaco factories- December 2000 / January 2001<ul style="list-style-type: none">• Preparation of Draft and Final-Report
Participants:	<ul style="list-style-type: none">- Khaled Hafez - CONCORD (meeting)- Mr. Talal Kreidieh - LEMATIC- Responsible Technicians of OPACO/CONCORD companies
Report is sent to:	<ul style="list-style-type: none">- Lematic - Mr. Kreidieh- UNIDO - Dr. Grof

Bau und Betrieb

Niederlassung Ulm

Benzstraße 17
D-89079 Ulm
Telefon (07 31) 49 15-2 30
Telefax (07 31) 49 15-3 60
www.tuevs.de
E-mail Karl-Josef.Richardt
@tuevs.de

Ulm, 18.01.2001
TÜV-BB-ULM/Ri-Ma
C5-Lem-Leb-03-01-Finalrep

This document contains:
33 Pages

TÜV Süddeutschland
Bau und Betrieb GmbH
Aufsichtsratsvorsitzender:
Karsten Puell
Geschäftsführer:
Roland Ayx (Sprecher)
Dr. Kurt Vinzens
Sitz: München
Amtsgericht München
HRB 96 869

File: C5/LEM-LEB/03/01



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1. OBJECTIVE AND SCOPE OF THE PLANT EVALUATION

The Lebanese Modern Industrial and Trading Co. Concord and Opaco factory in Beirut, Lebanon is operating polyurethane plants for the manufacture of refrigerators and Freezers.

As substitute for the previously used CFC blowing agent R 11, c-pentane (C5) is used now for the PU foam production. C5 is a flammable fluid constituting a class A1 hazard. The use of C5 necessitates fire and explosion protection measures for the C5 storage and the PU production facilities.

In conjunction with the progressive change-over to combustible blowing agents (C5) the experts of the Ulm branch of TÜV Süddeutschland have developed German and International safety standards and accumulated a wealth of expert knowledge in this field.

All safety evaluations by the TÜV experts are based on International, European and German standards and the experience gathered with plant inspections, the evaluation of solutions based on measurements and the investigation of accidents since the start of plant conversions in 1993. A special safety strategy was developed for fire and explosion hazards.

Safety evaluations by the TÜV experts basically cover the following tasks:

- Co-ordinate of the safety strategy with fire and explosion protection measures
- Review the feasibility of the proposed safety strategy
- Inspect existing buildings and technical facilities and components
- Functional testing of safety-related equipment at the plants
- Measurements at plant components under fire and explosion protection aspects
- Evaluate existing organisational procedures/requirements
- Review relevant parts of the documentation
- Define the state of the art of safety engineering by a comparison with plants used for similar purposes



2 DOCUMENTS AND INFORMATIONS USED AS A BASIS FOR THIS PLANT EVALUATION

2.1 Inspection

Before this final TÜV-inspection took place a pre-inspection of a similar Hennecke-foaming machine was carried out in Hennecke company/Germany (see Confirmation of Hennecke supply A 0100-769, data 1999-10-05).

On May 16th, 2000 a pre-inspection in the c5-storage area and on the foaming plants in Lematic workshop took place. The results hereof are listed in the TÜV Report Report No 1, File c5/Lem-Leb/01/00.

The final TÜV-inspection took place at 20th to 22th November 2000 in OPACO/CONCORD companies.

The present Final Report described the main matters of the realized safety strategy and the detected deficiencies and required measures.

The items were discussed with representatives of Lematic during the mission of TÜV in Beirut Lebanon.

Most deficiencies and measures, which came up during the inspection were solved by technicians of Lematic OPACO/CONCORD. The solved deficiencies were inspected by the TÜV experts on the last day of the mission again.

The deficiencies mentioned in the report of the TÜV pre-inspection File: C5/LEM-LEB/01/00 were solved. Deficiencies mentioned in this -final report were confirmed and stated by a letter of 18 January 2001 to the signed experts by the project leader Mr. Kreidieh.



2.2 Technical regulations

This plant evaluation is based on International, European and National regulations - in that order - as far as these are available and applicable.

These include the following essential regulations:

- International standards (ISO, IEC)
- Ordinance Regulating Facilities for Storing, Racking and Transporting combustible Liquids - Germany: VbF
- Decree for electrical plants in explosion dangerous areas, Germany: ElexV
- Decree for pressure vessels, Germany DruckbehV
- Law for immissions protection: Germany BImSchG
- Law for water protection: Germany WHG (protection against water-pollution)
- Electrotechnical regulations: International: IEC / European: EN / National: DIN VDE
e.g. IEC 60073, IEC 439-1/A2, IEC 204-1, IEC 1310-2, EN 50054, EN 50013, EN 50020, EN 50081, EN 60529, pr. EN 1050, DIN VDE 0165, EN 349, EN 418, EN 294
- Fundamental safety aspects to be considered for measurement and control equipment: Germany DIN V 19250
- Safety requirements for automated manufacturing systems: Germany VDI 2854
- Personal protection regulations / accidents prevention - European: EN..EC / Germany: UVV/ZH
e.g. VBG 1, VBG 5, VBG 61, ZH 1/200, ZH 1/255, ZH 1/8, ZH 1/10
- Technical regulations for combustible liquids and for gases: Germany TRbF / TRG
e.g. TRbF 100, 110 / TRG 280
- Ex-proof / spark-proof for ventilators: Germany VDMA-24169 part 1
- Homologation of technical plant and equipment - European: conformity certificates (e.g. PTB, Cesi, Damko)
- EN 378, Refrigerating systems and heat pumps, Safety and environmental requirements
- pr EN 1612-2 Reaction moulding machines
- EG machine directive (98/37/EG)
- CEI/IEG 335-2-24, Safety of household and similar electrical appliances
- IEC 79-10/EN 60079-10/VDE 0165 Part 101: Electrical apparatus for explosive gas atmospheres - classification of hazardous areas.



2.3 Documentation of the PU plants and the peripherals

The complete documentation of Lematic was delivered to the experts and following was available on site.

- a. Drawings related to Factory 2nd and 3rd floor factory of file from 20 November 2000.
- b. Hennecke PPT-Panel Control Diagrams RK 903051
- c. Technical description of barrel-pumps
- d. Mixing unit Pentamat 10 Hennecke
- e. Dosing Unit
HK 650 P/ML- A 7440-069
HK 270 P - A 7098-074
- f. Documentation of Zellweger Analytics
Catalytic sensor 780 (DMT certified) / PTB III B/E 29429
IR transmitter sensor PFG. : 413 00 297 NIV (certified for Pentane)
Control system 57 DMT certified (EN 50054, 50057)
DMT report related 5701 Control system (PFG-No 413 00 193)
- g. Ventilator Rosenberg Ex
Typ DD 165-70-4 suitable for Explosion zone 1 and 2
 - Mechanical part is made related VDMA 24 169
 - Motor (PTB No Ex95 D.3650)
 - Drawing related to ventilation of 2nd and 3rd floor
- h. Nitrogen pressure gauge Type PENVA- -PS/O-K-LCD (on c5 tank)
- i. Updated drawings
 - Hazard area rely (23.11.2000)
 - Zellweger Sensor rely 3rd floor No.:11128A (12.11.2000)
 - PU Machine room 3rd floor No.:10466 (24.05.2000)
 - Ventilation 3rd floor No.:10456 (10.10.2000)
- j. Nitrogen generator Italfilo - Release 2.02 - 1999



2.4 Documentation of Lematic

Test and Maintenance Procedures

- Step to charge and calibrate Nitrogen system
- Procedures in case of Leakage, Fire,
- PPT periodical maintenance
- Periodical tests for Foaming system, Hennecke
- Record for Foaming section test result



3. General definitions of c-pentane-foaming-plants

3.1 C5 safety data

Media	Hazard class	Flash point (°C)	Ignition temp. (°C)	Explosion-group	Temp. class	LEL / HEL (vol. %)	Density (air = 1)	Partially inert max. O ₂ (%)
Cyclo-pentane	AI	< - 30	380	II A	T 3	1.1 / 8.7	2.42	11

3.2 Definition of Zones

The areas of the zones are mentioned in this report are related to the realised safety strategy.

a) Explosion Zones

At the foaming plant which works with c-pentane following explosion zones are existing:

Explosion Zone 0

Explosion Zone 1

Explosion Zone 2

The physical definition of these ex-zones is based on standard 94/9/EG-Atex 100a.

The area definition of the checked foaming plants is based on the standard IEC 79-10.

For the plants which are using pentane a special safety strategy has been developed which contains also other relevant safety zones.

The size of the area of the explosion and safety zones of the particular plants are described under the consideration of the realised safety strategy.



b) „Alarm Zone„

The alarm zone is a zone which has been defined in relation with the pentane safety strategy by using particular parts of IEC 7910.

The definition is as follow:

Definition of alarm zone:

Defined area in which the development of an explosive atmosphere answering the description of explosion zone 0,1 or 2 is prevented by technical measures in accordance with IEC 79-10 and all potential sources of ignition are switched off automatically before an explosive atmosphere arises.

Technical measures in accordance with IEC 79-10 include:

- Plant sections carrying polyol / C5 must be technically leak-proof (e.g. special seals, leakage monitoring)
- Technical ventilation dimensioned in accordance with IEC 79-10 to reach a non dangerous zone
- Automatic gas warning system tested and certified in accordance with EN 50054 which automatically switches off of all potential sources of ignition at 40% LEL or lower.
- Only equipment which is absolutely necessary for operating the polyol / C5 plant must be installed within the alarm zone.

c) Fire danger zone

Around 5 m of the pentane-foaming plant a fire danger zone must be defined.

The installed technical equipment must meet following general requirements:

- The electrical equipment and units must meet the IEC-standards.
- Smoking and using fire is strictly forbidden.
- Special work with the danger of fire like welding and soldering is only allowed with a special permit.
- The flammable materials must be reduced to a minimum.

d) Zone of Nitrogen (N₂) inertisation

This is an area in which through the inertisation of N₂ no explosive atmosphere can be.



4. Results of inspection and evaluation of c5-storage area

4.1 Parts of TÜV inspection

Following plants and equipment are parts of this inspection:

- c-Pentane Tank area
- c5 tank
- c5 tank equipment

Not part of this TÜV inspection are:

- Polyol/Isocyanat-Storage areas

4.2 C5 storage area

4.2.1 Brief description of the plant

Pentane is stored in an underground tank with a capacity of 30.000 liters. This tank will be filled by truck.

The tank is located in a concrete basin inside of sand.

The c5-storage area is limited by walls and a door. For safety reasons this area is always controlled by personnel. A special cabin in the storage area is foreseen as guard room

The area into c5 will be released in case off leakage during the filling process is designed as a liquid catch basin.

Water gutters are structurally separate from the catch basin.

The sewage system is separated from the c5 catch basin by a special valve.

The electrical control panels are installed outside the explosion zone of the C5 storage area.

The c5 will be transported to the factory with a special intermediate tank (container) which is used inside the factory at floor 2 below the foaming wet part.



4.2.2. Explosion zones / fire hazard zone

Based on the above standards, the following explosion zones must to be defined:

a) Explosion zone 0

- The interior of the C5 storage tanks (without controlled inertisation)
- The interior of C5 pipes which are not constantly filled with C5

b) Explosion zone 1

- Inside the tank pit (only when there is an alarm by the gas-alarm-system)
- The interior of the C5 catch basin (during the unloading time)
- A circle with a radius of 1 m about the end of the C5 tank exhausting systems
- The environment of the equipment for connecting the c5-filling and vapour hoses in a circle with radius of 1.00 m

c) Explosion zone 2

- The environment of the c5 tank pit over a distance of 2,0 m up to a height of 0.8 m from the floor additional to the Zone 1.
- The environment of the equipment for connecting the c5-filling and vapour hoses behind the above defined zone 1 (1.00 m) in a circle with a radius of 1.00 m.

d) Fire hazard zone

- Total c5 storage area (minimum 5 m around the area)



4.2.3. Measurements / safety functional tests

- Pentane storage area -

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
1. Pentane emergency push button				
– pentane emergency push button (1 st level)		x		
2. Alarm signals to guard room		x		
3. c5 tank				
3.1 leakage monitoring:				
a. Double wall				
– minimum contact device 1		x		
– minimum contact device 2		x		
– maximum contact		x		
b. c5-membrane pump		x		
3.2 N ₂ -pressurization				
– N ₂ low		x		
– N ₂ min		x		
3.3 c5-level monitoring				
a. 30 m ³ tank				
– maximum level		x		
– super max. level		x		– use of key-switch for cancel this function is only allowed authorised persons
b. 2 m ³ container				
– super max. level		x		– plug and socket connection must be changed – see chap. 4.2.4 – only the electrical test was possible – see chap. 5.2.4
4. c5-basin				
– function of the sewage valve		x		
– slope of the basin		x		
5. Pressure testing of pentane pipeline		x		– test was done under supervision of Lematic – test record is submitted



Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
6. Gas warning system – 20 % LEL – 40 % LEL – system error		x x x		
7. Truck-grounding – blocking of unloading process		x		
8. Fire fighting system – Powder fire extinguisher – Water hydrant		x x		– automatic powder extinguisher above the tank – an equipment to increase the pressure is planned by Lematic
B) Measurements				
1. Electrical resistance of floor (conductivity) – position of tank-truck during unloading – explosion dangerous area around the tank-equipment	0.8 - 1.5 kohm 14 kohm	x x		
2. Ground/earth resistance – earth resistance • earth system • lightning protection – Potential equalisation • tank equipment • truck grounding	0.9 ohm 0.9 ohm ≤ 0.3 ohm 0.1 ohm	x x x x		– completions were necessary (confirmed)
3. Conductivity – racking hoses	1.0 kohm	x		– corrections were necessary (confirmed)
4. Electrical circuits/control panel – insulation resistance – over current protection – over voltage protection	≥ 30 mega ohm adjustments and system o.k.	x x x		



4.2.4 Detected deficiencies and required actions

- Pentane storage area -

1. Remark

Most deficiencies detected at the inspection has been solved by Lematic company during the inspection time.

The solutions were controlled by the TÜV experts at the last day of the inspection on site or during the inspection.

It was stated by Lematic that the deficiencies mentioned in the draft version of the Final report are solved.

Lematic company confirmed that all deficiencies are solved with the letter of 18 January 2001.

confirmed
by Lematic

x



5. Results of inspection and evaluation of the foaming plants on 2nd and 3rd floor

5.1 Task and method of inspection

5.1.1 Task

Following plants and equipment are parts of this inspection:

- c-Pentane intermediate tank area (2 m³-container)
- Pipes to the mixing units (Pentamat)
- Mixing unit / foaming machine
- Dryparts / foaming areas

5.1.2 Method

The basic way of the TÜV-inspection is the following:

- Visual check of plants and surrounding
- Technical check of the plants in detail
- Safety-relevant measurements
- Safety-relevant function tests
- Check of the documentation
- Check of the organisation matters related to safety
- Evaluation of the conditions in the environment of the plants
- Check of the safety equipments in the peripherals with influence of the Pentane plants.



5.2 c5 intermediate tank area (2 m³-container)

5.2.1 Brief description of the plant

Pentane is stored inside the factory in a tank with a capacity of 2000 l. This tank will be filled by pump from the 30 m³ storage tank.

The tank is located in a basin in a fire protected room inside the factory on floor 2nd.

The c5 pipe to the premix room is aboveground.

The area into c5 will be released in case of leakage during the filling process is designed as a liquid catch basin.

The electrical control panels are installed outside the explosion zone of the C5 storage area.

The room is technical is ventilated and controlled by gas sensors.

5.2.2. Explosion zones / fire hazard zone

Based on the above standards, the following explosion zones must be defined:

- a) Explosion zone 0
 - The interior of the c5 storage tanks (without controlled inertisation)
 - The interior of c5 pipes which are not constantly filled with c5
- b) Explosion zone 1
 - A circle with a radius of 1 m about the end of the c5 tank exhausting systems
- c) Explosion zone 2
 - The complete room is defined as explosion zone 2 in connection with the gas monitoring system and the technical ventilation.
 - The inside of the ventilation system of the storage room.
- d) Fire hazard zone
 - Total c5 storage area (minimum 5 m around the area)



5.2.3. Measurements / safety functional tests

- Area with the intermediate tank (2 m³-container) -

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
1. Pentane emergency push button – pentane emergency push button (1 st level)		x		– a correction was necessary
2. Alarm signals to guard room		x		
3. C5 intermediate tank 3.1 leakage monitoring: – gas sensors in basin 3.2 c5-level monitoring – super max. level (95 %) – low level		x x x		– function test must be carried out if the container is in the c5-storage area – the realisation of this function will be done (confirmed)
4. Pressure testing of pentane pipeline		x		– test was done by Lematic – test record is submitted
5. Gas monitoring system – 20 % LEL – 40 % LEL – system error		x x x		
6. c5-feeding pump – leakage monitoring		x		
7. Fire fighting system – Powder fire extinguisher – Fire resistance flaps in the ventilation channels		x x		– automatic powder extinguisher are installed in the room – the flaps were not installed - see chap. 5.2.4 (confirmed)



Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
1. Electrical resistance of floor (conductivity) – explosion dangerous area	10 kohm	x		
2. Ground/earth resistance – earth resistance • earth system • lightning protection – Potential equalisation • the entire room	0.5 ohm 0.9 ohm ≤ 0.3 ohm	x x x		– a correction was necessary (confirmed)
3. Conductivity – racking hoses	1.0 kohm	x		
4. Electrical circuits/control panel – insulation resistance – over current protection – over voltage protection	≥ 30 mega ohm adjustments and system o.k.	x x x		



5.2.4 Detected deficiencies and required actions

- Area with Pentane intermediate tank (2 m³-container) -

1. Remark

Most deficiencies detected at the inspection has been solved by Lematic company during the inspection time.

The solutions were controlled by the TÜV experts at the last day of the inspection on site.

It was stated by Lematic that the deficiencies mentioned in the draft version of the Final report are solved.

Lematic company confirmed that all deficiencies are solved with the letter of 18 January 2001.

confirmed
by Lematic

x



5.3 Pre-mix area and foaming machines 2nd and 3rd floor (wet parts)

5.3.1 Brief description of the plant

In the 2nd and 3rd floors are wet parts with the same pre-mix unit, the same foaming machine and the same design of the relevant peripherals (e.g. cabin, ventilation etc.)

Each wet part consists of a pre-mix unit, a polyol /c5 day tank and a high pressure pump. This equipment is installed on a plate form. The entire polyol /c5-tank isocyanate wet parts are inside a cabin.

The Hennecke/pre-mix unit Pentamat 10 is used. The Pentamat has an own enclosure and is located near the dosing machine on the same pedestal.

The Pentane feeding pipe is installed above ground. Before this pipe enters this part of the production a automatic valve („Fail safe Valve,“) is mounted.

The pipe is completely welded and designed as a high pressure pipe.

The electrical control panels for the Pentamat are installed outside this enclosure.

The two central panels of the gas monitoring systems are positioned on this plate form also, but outside of the cabin.

For the pentane safety systems, there are two control panels which are carried out on the base of the Hennecke PPT-control system.

Nitrogen for the inertisation systems is produced by a N₂-generator.

The power back-up system consists of UPS's and of the redundant generator plants of OPACO/CONCORD.

Further details are described in the Hennecke/Lematic documentation.



5.3.2 Zone Definitions and Dimensions

a) Alarm-zone

- The cabins with the wet parts plants.
- The total enclosure of Pentamat.

b) Explosion Zone 2

- The interior of the exhausting system
- A circle with a radius of 2 m about the end of the exhausting system at the open air.

c) Zone of nitrogen inertisation

- The interior of the polyol/c5-tank

d) Fire danger zone

- The surrounding area of 5 m around the wet parts



5.3.3 Measurements/Function tests

- Wet part plants of the 2nd and 3rd floor
- c5-safety control panels (PPT)
- Back-up supply
- Nitrogenerator

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
– Wet part plants				
1. Gas warning system				
– 20% LEL		x		
– 40% LEL		x		
– system error		x		
2. Emergency push-button				
– pentane emergency push button (1 st -level)		x		
– Emergency push button (control panel)		x		
3. Alarm signals to guard place		x		
4. Exhausting system				
– flow sensor		x		
• Pentamat		x		
• Room ventilation				
– test smoke		x		
– functions 20 % LEL		x		
5. c5 / polyol tank				
– N ₂ -minimum		x		
– super max. level		x		
– temperature maximum		x		
6. Exit lamps		x		
7. Fire fighting system				
– automatic powder extinguisher		x		
– water hydrants		x		
8. Leakage control system (MK)				
– c5/polyol feeding pump / distribution		x		
• pre alarm				
• alarm				
– Pentamat		x		
• pre alarm				
• alarm				



Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
10. P-max. control				
– Pentamat		x		
– c5/polyol feeding pipe		x		
B) Measurements				
– wet part plants				
1. Electric resistance of floor (conductivity)				
– floor in the room	5 - 10 kohm	x		
2. Ground/earth resistance				
– earth resistance				
• earth system	0.7 ohm	x		
• lightning protection (ventilation system)	0.7 ohm	x		
– Potential equalisation				
• Pentamat, tank, pumps	≤ 0.3 ohm	x		
• plant equipment (pipes, ventilation channels)	≤ 0.3 ohm	x		– additional necessities were carried out during inspection
3. Electrostatic field strength				
– windows of the room-enclosure	max. 5.0 kV/m	x		
– insulation of tank, pipes etc	0 kV/m	x		
4. Electrical circuits/control panels				
– Insulation resistance	50 Mohm			
– over current protection	adjustment o.k.	x		
5. Exhausting system				
– Fan wet part	– 7,2 m/s	x		
– Emergency fan wet part	– 5,8 m/s	x		
C) c5-safety control panel (PPT)				
1. Function tests				
– monitoring of circuit breakers and fuses		x		
– push button for testing of signalling		x		
– supply by UPS		x		
– supply by generator		x		
2. Presence and adjustment-control				
– timer relays		x		
– over current protection device		x		
– over voltage protection		x		
3. Measurements				
– circuits-insulation	≥ 30 mega ohm	x		



Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
D) Back-up Generator / UPS				
1. Function tests <ul style="list-style-type: none"> – running without load – running with load – automatic start in case of power failure 		x x x		
E) N₂ - Generator				
1. Function tests <ul style="list-style-type: none"> – max. O₂-concentration – automatic functions in case of max. O₂ 		x x	-	<ul style="list-style-type: none"> – a correction was necessary – a final clarification is necessary (see chap. 5.3.4) (confirmed)



5.3.4 Detected deficiencies and required actions

- Wet part plants 2nd and 3rd floor
- c5-safety control panels (PPT)
- Back-up supply
- N₂-generator

1. Remark

Most deficiencies detected at the inspection has been solved by Lematic company during the inspection time.

The solutions were controlled by the TÜV experts at the last day of the inspection on site.

It was stated by Lematic that the deficiencies mentioned in the draft version of the Final report are solved.

Lematic company confirmed that all deficiencies are solved with the letter of 18 January 2001.

confirmed by Lematic
x



5.4 Cabinet and Door lines on 2nd and 3rd floor

5.4.1 Brief description of the plants

The dry part plants are similar in the 2nd and 3rd floor.

Inside of good ventilated areas are two circles with the jigs.

For each circle an own mixing head is installed. With these mixing heads the jigs for cabinets and doors can be supplied. The heads are suspended on rotating cranes. The pouring position of the mixing heads is controlled by proximity switches on the cranes, that means the size of the mould, the calculated amount of foam and the need of nitrogen are monitored.

For the injection the mixing heads are led manual by the operators. Before pouring the nitrogen flushing into the moulds will be done via the mixing heads.

The jigs are equipped with electrical heatings.

The areas with the jigs and the jigs itself are artificial ventilated and controlled by gas sensors. In case of pentane-gas alarm an emergency suction is designed.

5.4.2 Zone definitions and dimensions

- a) Alarm zone
 - The fictitious room around the jigs with a distance of 1.50 m.
- b) Explosion zone 2
 - The interior of the exhausting system
 - A circle with a radius of 2 m about the end of the exhausting systems at the open air
- c) Zone of Nitrogen inertisation:
 - The interior of the refrigerator cabinets after flushing by nitrogen
- d) Fire hazard zone
 - A surrounding of 5 m around the wet-parts and the dry-parts.



5.4.3 Measurements / Function tests

– Cabinet and door lines on 2nd and 3rd floor -

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
1. Gas warning system				
– 15 % LEL		x		
– 30 % LEL		x		
– system error		x		
2. Emergency push-button				
– pentane emergency push button (1 st level)		x		
– emergency push button (control panel)		x		
3. Alarm signals to guard place		x		
4. Exhausting systems				
– flow sensor				
• dry part 2 nd floor		x		– some corrections were necessary
• dry part 3 rd floor		x		
– emergency ventilation				
• dry part 2 nd floor				
• dry part 3 rd floor				
– test smoke		x		
– functions 20% LEL		x		
5. Leakage system				
– stream distributor 2 nd floor		x		
– stream distributor 3 rd floor		x		
6. Fire fighting system				
– extinguishers		x		
– water hydrants		x		
7. N ₂ -inertisation of cabinet and doors				
– 2 nd floor		x		
• N ₂ -pressure monitoring				
• N ₂ -flow monitoring		x		
• Quality of inertisation		x		
– 3 rd floor				
• N ₂ -pressure monitoring		x		
• N ₂ -flow monitoring		x		
• Quality of inertisation		x		



Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
1. Electrical resistance of floor (conductivity)				
– dry parts				
• 2nd floor	15-30 kohm	x		
• 3 rd floor	5-20 kohm	x		
2. Ground/earth resistance				
– earth resistance				
• earth system	0,7 ohm	x		
• lightning protection (ventilation system)	0,7 ohm	x		
– Potential equalisation				
• dry part plants	≤ 0.3 ohm	x		
• jigs	0.3 ohm	x		
• mixing heads	0.3 ohm	x		
3. Electrical circuits / control panels				
– insulation resistance general	≥ 30 mega ohm	x		
– over current protection	o.k.	x		
– insulation resistance of jig heads				
• 2 nd floor	≥ 1 mega ohm	x		
• 3 rd floor	≥ 1 mega ohm	x		– jig 2: resistance is to low (see chap. 5.4.4) (confirmed)
– Interlocking of heating circuits before pouring:				
• jigs 2nd floor		x		
• jigs 3rd floor		x		– changes were necessary here.
5. Exhausting system				
– Fan	– 7,7 m/s	x		
		x		
– Emergency Fan	– 7,8 m/s	x		
		x		
6. Inertisation				
– flushing time	– 8 s	x		
– O ₂ concentration	– 10,7 % O ₂	x		– < 11,7 % O ₂



5.4.4 Detected deficiencies and required actions

– Cabinet and door lines on 2nd and 3rd floor -

1. Remark

Most deficiencies detected at the inspection has been solved by Lematic company during the inspection time.

The solutions were controlled by the TÜV experts at the last day of the inspection on site.

It was stated by Lematic that the deficiencies mentioned in the draft version of the Final report are solved.

Lematic company confirmed that all deficiencies are solved with the letter of 18 January 2001.

confirmed
by Lematic

x



6. Safety relevant working conditions of the pentane foaming plants

6.1 Organisational requests

To run these plants in safe conditions following safety requirements are essential:

- All parts of the machine documentation and operator instructions must be followed
- The safety checks must be done regularly.
The results of the checks must be recorded.
The management must follow the pending points
- The management, team leader and technicians which are in charge of the plants must be educated regularly by experienced people.

6.2 Change of units of the plant

Before units or parts of the plants related to safety will be changed experienced people must be consulted.

This must be people of the supplier of the machines related to the process and the signed experts related to the safety.

6.3 Regularly inspections

6.3.1 General requirements

According to the safety strategy regularly safety inspections, maintenance and function tests must be done.

The aim is to keep the safety related to water protection, fire and explosions on the highest level and run the plants according to the state of the art.

The work must be done by internal experienced technicians (competent people) and by the signed TÜV experts.

Definitions:

Competent people (CP)

Experienced people must have a special education of the plant and of the safety issues.



Experts

6.3.2 Safety relevant checks, organisation and education

No	Plant	Kind of check	Qualification	Check time
1	Foam plant complete	Visual check	CP	daily
2	Foam plant complete	technical maintenance	CP	monthly
3	Safety equipment e.g. Pentan control system, ventilation, grounding system, fire detection/fighting system, warning signs	visual check	CP	monthly
4	Safety equipment E.G. gasalarm system, Inertisation, Battery supply	technical inspection	CP	monthly
5	Gasalarm system	calibration of sensors	CP	each 6 month
6	Foamplant complete and relevant surrounding	- visual check - function check	CP	yearly
7	Organisation - Records of check - training of people - Records of changes	check the documents	CP Management	yearly
8	Training	theoretically and practically	CP or Experts	yearly
9	Foamplant complete	check of all safety relevant aspects	Experts	each 3 year
10	Essential changes of the foaming plant or safety parts	check of all safety relevant aspects	Experts	before run the plant again



In case of special incidents and especially accidents (fire, explosion, human accident) the signed experts must be informed immediately.

- The experts get the yearly record of the internal competent people (CP's) of Lematic.
- Information about the training of the CP's must be available.
- The experts can visit the factory at any time (e.g. on request of UNIDO)

- Opaco and Concord factories fulfilled all safety requirements.
- Runs the factory on the highest safety level according to the state of the art
- Runs the plants only with the installed safety equipment
- All requests, mentioned in this report are fulfilled.



7. Conclusion

7.1 Safety aspects for the pentane storage and foaming plants:

Handling of the deficiencies

1. The TÜV Süddeutschland, branch Ulm, got a report with the confirmations about the solved deficiencies signed by Lematic Mr. Kreidieh.
2. The mentioned list is complete, therefore TÜV-experts issue the certificate.

7.2 Summary of the TÜV inspection

The technical safety requests, regarding the safety strategy for c5-plants are fulfilled.

The signed TÜV-experts have no safety related doubts concerning the process with the pentane-plants.

The safety against danger of fire and explosion because of using c-Pentane has been reduced to a possible minimum.

7.3 Remarks together with the issue of the certificate

The inspection of the installation of the related plants of UNIDO Project took place from 20th November 2000 to 22nd November 2000.

The Concord and Opaco companies will be allowed to hold a safety certificate for the related plants.

The Certificate is only valid if the companies will fulfil all requirements mentioned in this report.

The next regular safety inspection carried out by experts must be done till end of November 2003.

This Certificate will be valid till November 2003.

The experts

K.-J. Richardt

E. Mack

Attached is the certificate of Concord and Opaco



LEMATIC

THERMOTECHNIK HANDELS GMBH

LEMATIC Thermotechnik Handels GmbH - Berliner Allee 40 - D-40212 Düsseldorf.

United Nations Industrial Development
Organization (UNIDO)
Purchase and Contracts Section,
General Services Branch
Administrative and Financial Control.
Field Operations and Administration Division
P.O.Box 300
A-1400 Wien
AUSTRIA

LEMATIC Thermotechnik Handels GmbH
Berliner Allee 40
D-40212 Düsseldorf
Telefon 0211 - 327941
Telefax 0211 - 327968

Kto.-Nr. 1358720 Commerzbank Düsseldorf (BLZ 300 400 00)
HRB 17419 Amtsgericht Düsseldorf,

Düsseldorf, Dec. 22nd. 2000

Invoice No. UNI/A-L 99100/9

Description	Total U.S.Dollars
Payment in accordance to the para 5.05 d) of the contract no. 98/247	
Total in U.S.Dollars	
Only U.S.Dollars Two/Nine/Zero/Zero/Zero. And 00 %	29,000.-
	<u>29,000.-</u>

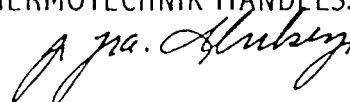
PAYMENT INSTRUCTION:

Bank name and address: COMMERZBANK AKTIENGESELLSCHAFT
DÜSSELDORF BRANCH, (BLZ 300 400 00)
P.O.Box 101137
BREITE STRASSE 25-27
D-40213 DÜSSELDORF — GERMANY

Account no. : 600 1358720/01 USD

Account of : LEMATIC THERMOTECHNIK HANDELS GMBH

LEMATIC THERMOTECHNIK HANDELS.GMBH



LEMATIC

THERMOTECHNIK HANDELS GMBH

LEMATIC Thermotechnik Handels GmbH, Berliner Allee 40, D-40212 Düsseldorf.

Lebanese Modern Industrial and Trading Co.

Tel: +961-1-789401

Fax: +961-1-789407

Na'ameh – LEBANON

LEMATIC Thermotechnik Handels GmbH

Berliner Allee 40

D-40212 Düsseldorf

Telefon 0211 - 327941

Telefax 0211 - 327968

Kto.-Nr. 1358720 Commerzbank Düsseldorf (BLZ 300 400 00)
HRB 17419 Amtsgericht Düsseldorf,

Düsseldorf, May, 28th. 99

Att: Dr. Bassam Hafez, Managing Director

Ref: - Contract No. 98/247/VK

- Project No. MP/LEB/97/084

- Phasing-out CFC's at Lebanese Modern Industrial & Trading Co./Lebanon

Dear Sir,

In accordance to the implementation of above mentioned project, we would like to recommend you to have following systems that will be absolutely necessary to achieve normal production in your factories. These systems were listed in priority according to their need to the project.

Item	Description	Qty	Estimated Total Price
1	Helium charging, testing and recovery unit, such unit is used in most of refrigerator factories to check any leakage of cooling units for new products at production lines. Manufacturers: Galileo - Italy / model ASTRA A/TS A'Gramkow - Denmark / model HRS6-1 + PROTEC + TL4.6	2 units	\$145000.-
2	We recommend you to have new evacuation stations as the status of the existing stations may not be reliable after renovation, noting that usually such stations may have unstable performance after renovation. Manufacturers: Galileo - Italy / model D18 ECO with Pirani gauge	20 stations	\$75000.-
3	Ratio output controller for the PUR high pressure foaming machine model HK 650 P/ML, this controller will control the quantities and ratios of Isocyanate and Polyol/Cyclopentane before flowing to mix-head. Noting that the project covers only one controller for the existing PUR high pressure machine model HK270 after retrofitting.	1 unit	\$9700.-
4	Polyol day tank to prevent interruption of production, as per our experience in such project, we recommend to use day tank.	2 units	\$30000.-

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LEMATIC Thermotechnik Handels GmbH, Berliner Allee 40, D-40212 Düsseldorf.

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D-40212 Düsseldorf
Telefon 0211 - 327941
Telefax 0211 - 327968

Kto.-Nr. 1358720 Commerzbank Düsseldorf (BLZ 300 400 00)
HRB 17419 Amtsgericht Düsseldorf,

Düsseldorf.

Item	Description	Qty	Estimated Total Price
5	Flow testing unit, to check blocking inside refrigeration unit tubes caused by oil or other materials.	2 units	\$40000.-
6	High efficiency production leaks detectors (Halogen type) for HFC-134a similar to the two units that will be supplied in terms of our contract with UNIDO. This contract covers two units, which we consider will not be enough for the production capacity at your factories. Manufacturers: Leybold / model: HLD 400A	2 units	\$20000.-
7	Halogen handheld leaks detectors for HFC-134a, low accuracy similar to the two units that will be supplied in terms of our contract with UNIDO. This contract covers two units, which we consider will not be enough for the production capacity at your factories.	20 units	\$6000.-

Our advice to have above systems is based on our accumulated experience in such refrigerator projects. For example, our company executed similar project for the account of UNIDO in Syria (Al-Hafez co.), This project is still having stability problems in terms of quality because they do not have such systems as we are recommending herein.

The above items were not included in our offer to UNIDO as they did not include them in their Terms of Reference but we strongly stress to fit above systems in your factories. Lematic is committed to carry-out the project as per Terms of Reference and accordingly as per our contract with UNIDO, but Lematic cannot take responsibility to take guarantee of quality control and interruption in the normal flow of production without installing the above mentioned systems.

We recommend also that personnel of both factories OPACO and CONCORD should get trained in current redesign practical training on assembling and testing of new systems.

Thanking you in advance for your kind attention and cooperation.

Sincerely Yours,

LEMATIC THERMOTECHNIK Handels GmbH


Talal Kreidieh
Project Team Leader