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TÜV
SÜDDEUTSCHLAND

FINAL REPORT

on Technical Plant Inspections and Evaluations

Middle East Electrical Industries, Jordan

Plant location: Middle East Complex
Amman Industrial City
JORDAN

Responsible / Experts: Karl-Josef Richardt, TÜV-BB
Hans-Joachim Berger, TÜV-BB
Companygroup TÜV Süddeutschland

Project: UNIDO Contract No. 97 / 097 with BONO SISTEMI

Order No.: 98 024 3220-2 and 98 025 3126

Dates:
July 1998
- Plant inspections and evaluations on location
October 1998
- Final Plant inspections and evaluations on location
August 1998
- Preparation of commission list
- Meeting on Bono Sistemi
October 1998
- Preparation of final commission list
April 1999
- Preparation of final report
May 2000
- Report after got final confirmation

Participants on location:

- Mrs. Barale	- Bono Sistemi
- Mr. Pulici	- Cannon Afros
- Mr.Guerra	- Cannon Afros
- Mr. Khalili	- MEC
- Mr. Thabbat	- MEC
- Mr. Ghandour	- MEC

Bau und Betrieb

Niederlassung Ulm
Dampf und Druck

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Ulm, 2000-05-11
TÜV BB-ULM-RI/Be
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ecRep01-00.doc
File-No.: Bon/MEC-JO/01/00

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1. OBJECTIVE AND SCOPE OF THE PLANT EVALUATION

The Middle East Complex in Amman, Jordan is operating polyurethane plants for the manufacture of refrigerators.

As substitute for the previously used CFC blowing agent R 11, c-pentane (C 5) is used now for the PU foam production. C 5 is a flammable fluid constituting a class AI hazard. The use of C 5 necessitates fire and explosion protection measures for the C 5 storage and the PU production facilities.

In conjunction with the progressive change-over to combustible blowing agents (C 5), 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.

The safety evaluations by the TÜV experts basically have covered 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
- Review 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 Plant inspections

The signed TÜV - Experts carried out 2 safety plant inspections.

The results of this inspections are reported in following documents:

Commission List
on Technical Plant Inspection and Evaluations
Middle East Electrical Industries, Jordan
File No.: MEE-JO/01/98-MEEcom1, Rev. 0, 6 October 1998

Final Commission List
on Technical Plant Inspection and Evaluations
Middle East Electrical Industries, Jordan
File No.: MEC-JO/03/98-MEC Finalcom3, Rev. 2, 16 December 1998

The items were discussed with representatives from MEC and Cannon Bono during the inspections.

The pending points were additional discussed with Bono and Cannon Afros during meetings in Milan.

During the meetings in MEC the responsible people of the MEC factory and of the Supplier Cannon Bono agreed about the responsibility to solve the pending points according to our Commission List.

After our 2 inspections we could be sure, that the most important safety equipment was installed.

Therefore we did not require an additional review because we learned that Siltal and Bono could finish the job in a proper way.

But we requested that all our demands in our report has to be fulfilled till start up and we get a written confirmation by Bono and MEC.

We got a letter:

- From MEC dated 16 December 1998

and the confirmation

- from Bono Sistemi dated 14 December 1998

After receiving this letter/confirmation we have prepared the final report. (Bon/MEC-JO/01/00 from 28 April 1999).

With letter from 12 February 2000 we got also the confirmation by MEC that all pending points are solved. For that reason we are able to issue the certificate together with this report.

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 DINV 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 (89/392/ESG, revised edition 91/368/EEC)
- 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 from Cannon Afros and Bono Sistemi

a) Declaration of compliance in accordance with the directive 89/392 Cee and following modifications.

b) Documentation about A System 100 Penta Twin

- Documentation about Penta Easy Froth 20 + 4 Twin

including: e.g. Flow diagrams
Electrical diagrams
Component informations
Relevant Component Certificates / like PtB, LCIE, use and Maintenance information's
Documents about the ISPESL Certificates of the pressure vessels

c) Documents about the Pentane-Storage area

included: Layout
Drawing of tank
General P & I Diagram

d) Detailed documentation about items

used in: storage Tank
Wetpart
Drypart

3. INSPECTIONS AND EVALUATIONS

3.1 Safety aspects related to organization

3.1.1. The existing situation is as follows:

a) Guard room

A constantly manned guard room is available. Prealarm and alarm signals from the C 5 plants are transmitted to this room. The personnel manning the guard room has been trained for taking any emergency action that may be required to protect the C 5 facilities.

b) Job instructions

Written job instructions are available at relevant points of the C 5 facilities.
For the benefit of the TÜV experts, these instructions were orally translated to English.
The workers serving these facilities have received special training.

c) Fire protection

Fire extinguishers are available in the area of the C 5 facilities.

Fire extinguishers and water hydrants are available throughout the production area.
The above ground tank is especially sprinklered.

d) Evacuation of personnel

The procedure to be followed in the event of an alarm trigged by a C 5 facility is organized, i.e. specially trained persons rush to the facility causing the alarm, all others escape to the open air.
Suitable escape routes available.

e) Maintenance / inspections / testing

Persons engaged in servicing and inspecting the plants have received special training.
Tools and other personal aids for the C 5 plants are available.

f) Official bodies

MEC confirmed that the responsible official bodies were informed about the C 5 and there are no particular requests.

3.1.2 Deficiencies / recommendations

Deficiencies detected or recommendations related to C 5 subjects have been listed in the TÜV Commissioning List.

3.2 C 5 storage area

3.2.1 Brief description of the plant

Pentane is stored in an aboveground tank (see drawing D 300 B 1 206). These tank is filled from drums.

The tank is located in a basin.

The C 5 pipe to the premix room is aboveground.

The area in which C 5 will be released in the event of leakages 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 C 5 catch basin.

The electrical control panels are installed outside the explosion zone of the C 5 storage area.

3.2.2. C 5 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 2	1.1 / 8.7	2.42	11

3.2.3. Explosion zones / fire hazard zone

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

a) Explosion zone O

- The interior of the C 5 storage tanks (without controlled inertisation)
- The interior of C 5 pipes which are not constantly filled with C 5

b) Explosion zone 1

- 1,5 m around the tank
- The interior of the storm water catch shaft (C 5 catch basin)
- A circle with a radius of 1 m about the end of the C 5 tank exhausting systems

c) Explosion zone 2

- The environment of the C 5 tank shafts over a distance of 3,5 m up to a height of 0.8 m from the floor additional to the Zone 1.
- The water drainage shafts in the region of the C 5 storage area

d) Fire hazard zone

- Total C 5 storage area (minimum 5 m around the basin)

3.2.4. Measurements / functional tests

Record after the second inspection

Plant/component	Measuring result	Conforming to safety strategy yes	no	Remarks
1. Sprinkler System		x		see Commiss. List
2. Pentane emergency pushbutton			x	see Commiss. List
3. Remote signals guard room		x		
4. C 5 tanks - leakage system		x		Commiss. List
5. C 5 tank-pressure monitoring system		x		
6. Electrostatic measures - total plant - details	 < 2 kV / m window of enclosure > 300 kV/m after insert of metal stripes	 x		see Commiss. List
7. Ground resistance / potential equalisation - total plant	 ≤ 0.1 ohm	x x		
8. Electrostatic resistance - total plant - details	 < 10 kilo-ohms racking hoses 10^6 ohms	 x x		see Commiss. List
9. Electric circuits - insulation resistance - overcurrent protection - UPS - test broken wires	 > 30 mega ohm O.K.	 x x x x		
10. Pressure testing of pentane pipeline	confirmed by Bono	x		sufficient for working pressure
11. Further functional tests				Commiss. List

3.2.5 Deficiencies detected / action required

The deficiencies detected during inspection of the C 5 storage area and the measures had to be done after our inspection are listed in the TÜV Commissioning Lists.

3.3 Premix area/Polyol/C 5-wetparts and foaming machines

3.3.1. Brief description of the plant

All sections except the pipes of the plant in which C 5 is used are installed in a separate enclosure.

The plant is described in the documentation mentioned in chapter 2.3 and the layout No. D 400 B 1177.

3.3.2 Polyol / C 5 safety data

The safety requirements for the polyol / C 5 mixture are from safety point of view similar to those for C 5.

3.3.3. Zone definitions

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

a) Alarm zone

1. Wetpart: within the enclosures with the polyol / C 5 tanks, Easytroth and with the high-pressure pump units
2. Foaming machines: the interior of the enclosures (rooms) with the foaming machines

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 / C 5 must be technically leakproof (e.g. special seals, leakage monitoring)

Technical ventilation dimensioned in accordance with IEC 79-10

Automatic gas warning system tested and certified in accordance with EN 50054 which automatically switches off all potential sources of ignition at 40% LEL or lower.

Only equipment which is absolutely necessary for operating the polyol / C 5 plant may be installed within the alarm zone.

b) Explosion zone 1

1. Foaming machines: a circle with a radius of 20 cm about the injection hole and 20 cm about the upper part of the mounted cabinet while the foam is rising.

c) 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
- A circle with a radius of 3 m about flanged joints, projected down to the floor, unless an alarm zone is defined or a special seal is used

d) Areas in which explosive atmospheres are prevented by inertisation

- The interior of the polyol / C 5 storage tank

e) Fire hazard zone
An area of 5 m about the enclosures.

3.3.4. Measurements / functional tests

Record of test results after the 2nd inspections

Plant/component	Measuring result	Conforming to safety strategy yes	Conforming to safety strategy no	Remarks
1. Gas warning system - 20% LEL - 40% LEL - system error		 x x x		
2. Pentane emergency pushbutton		x		
3. Remote signals guard room	signal of backup generator	x	x	
4. Exhausting system - pressure switch - test smoke - functions 20% LEL/40% LEL/emergency pushbutton / circuit switch	foaming mach. O.K.	 x x x		
5. Leakage system - basins - pumps		 x x		
6. Polyol / C 5 tank - supermax - N_2 -min - electrical heating		 x x x		
7. Door monitoring (wetparts)		x		
8. Foaming machines - blocking electr. heater - blocking foam open with manual switch - position control of mixing head		 x x x		
9. Electric circuits - insulation resistance - overcurrent protection - UPS - test broken wires	> 30 mega ohms O.K.	 x x		no complete measurement
10. Electrostatic measures - total plant - foam closing/opening - details	< 2 kV / m 3-5 kV / m ripped windows of enclosure > 300 kV / m after metal stripes was mounted	x x x		 see Commiss. List

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
11. Ground resistance / potential equalization - total plant	≤ 0.1 ohm	x		
12. Inertisation foaming machines - pressure monitoring - N_2 flow measurement - time monitoring - quality of inertisation (position monitoring)	O_2-concentration 7,6 %	x x x x		
13. Further functional tests				see Commiss. List

3.3.5 Deficiencies detected /action required

The deficiencies detected during inspection of the wetparts and the foaming machines and the measures had to be done after our inspection are listed in the TÜV Commissioning Lists.

All safety related parts of the plant must be checked regularly according to the requirements in the Cannon documentation.

These safety checks must be recorded and signed by the responsible person.

4. Conclusion

The inspection of the installation of the MEC Factory, UNIDO Project No. 97/097 took place.

MEC and Bono Sistemi has confirmed that all deficiencies detected during the TÜV inspection and evaluation in April 1998 and July 1998 of the related c-Pentane plants, listed in the Commission List mentioned in Chapter 2.1 has been fulfilled.

The above mentioned plant fulfill all important safety standards and the requirements of the TÜV Süddeutschland Branch Ulm experts.

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

The MEC Factory in Amman, Jordan get a safety certificate together with this report.

The certificate is valid till 10/2001. After that date a new safety certification is needed.

The experts

signed
K.-J. Richardt

signed
H.-J. Berger

Cannon polyuretane technology	DOC N.	CR98/103
	Object	Phasing out of CFC's at MEE
	Contract	UNIDO N. 97/097

FINAL REPORT

RETROFITTING OF THE REFRIGERATOR CABINET AND DOOR FOAMING PLANTS FOR THE REPLACEMENT OF CFC WITH CYCLOPENTANE AS BLOWING AGENT

D		1			
C					
B	18/05/00	FINAL ISSUE	M. BARALE		
A	26/04/99	FIRST ISSUE	M. BARALE		
Rev.	Date	Description	Prepared	Controll.	Approv.

11. INTRODUCTION

With the present document the Contractor wants to describe the works performed at the plant site for the conversion of the Middle East Company factories to phase out the use of CFC in the production of Domestic Refrigerators

Here below it is briefly summarised the activities performed under the Contract step by step according to The terms of Reference

2. LAY OUT OF THE PLANT /REDISIGN OF EXISTING

After the award of the order the Contractor visited the Counterpart between May 10th and 11th 1997 in order to verify the conditions of the site and to identify the best engineering solutions for the conversion of the existing foaming lines.

During the visit, the Contractor discussed and checked with the Counterpart the following main subjects:

A - Technical details regarding the supply of the equipment; in particular The Contractor emphasised the Premix Unit, the Polyol Module, Safeties of the plant (as i.e.: gas sensors, exhaust system with fan groups), cyclopentane storage tank and relevant accessories .

B - The suitable site where the new equipment had to be installed and the required modification to the new layout.

Regarding the C5 storage tank, The Contractor inspected and defined the area where it had to be positioned.

After the visit the Contractor prepared the first progress report including the preliminary lay-out and the Basic requirements and specifications for the site Preparation.

The first progress report covered all the subjects listed during the discussion and gave to the Counterpart, as much as detailed as possible at that phase of the project, a list of all the works and materials to be provided by them.

3 REDISIGN OF EXISTING EQUIPMENT/ AWARD OF SUBCONTRACT FOR MODIFICATION OF THE PLANT

In October 1997 the Contractor provided the Final Technical Documentation for the Conversion of the plant.

The above mentioned documentation included the following kind of detailed drawings and specifications:

- civil works for the storage tank and foaming lines
- grounding of the equipment
- piping arrangements and support details
- piping sketches
- box buildings construction
- ventilation construction
- cable run lay-out
- gas sensor positioning
- electrical drawings
- safety requirements

All the documentation was discussed with the Counterpart and some modifications have been agreed during the next period.

4. DELIVERY OF EQUIPMENT/INSTALLATION

In December 1997 all the new equipment have been shipped.

A team of engineers attended the training at Contractor site (abroad)

The installation started in May1998 , after the customs clearance of all the equipment.

The Contractor engineers followed the installation phase with the supervision of the job at Counterpart charge.

The Contractor's actions basically concerned the following zone of the modified plant:

- Cyclopentane storage tank area
- Wet area
- Process fluid connection piping between wet and dry areas
- Cabinets /doors foaming areas

The installation phase was completed in July 1998

5. COMMISSIONING. TRIAL PRODUCTION OF THE FIRST MODELS, TEST RUN OF PRODUCTION

After the installation phase the Contractor performed the Commissioning phase of the modified plant in accordance with the contract.

In November 1998 the commissioning phase has been completed.

The training on the job activities has been carried out during the commissioning phase

The commissioning , trial production and test run phases mainly concerned the following operations:

- Pneumatic and Electric circuit check
- Grounding check
- Flushing of the tanks and the piping with nitrogen
- Pressure test
- Check of the operating sequences
- Operating test
- Service simulation test
- Setting start-up parameters
- Foaming quality check
- Performance test

The training on the job activities has been carried out during the commissioning phase.

6. SAFETY CERTIFICATION

The safety inspection has been performed in July and October 1998 by TUV ULM .

Enclosed please find the TUV final report and the TUV safety certificate.

7. STARTING MASS PRODUCTION

After the commissioning phase the Contractor performed the starting of the mass production in November 1998.

During our last visit (February 2000) the Contractor visited the plant in order to have visited the plant to monitor the performance of the whole plant installation.

The result of the visit has been positive.

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証書 ◆ СВИДЕТЕЛЬСТВО ◆ CERTIFICADO ◆ CERTIFICAT

CERTIFICATE

No.: TÜV- BB-UL 98 025 3126
98 024 3220-2

This is to certify that

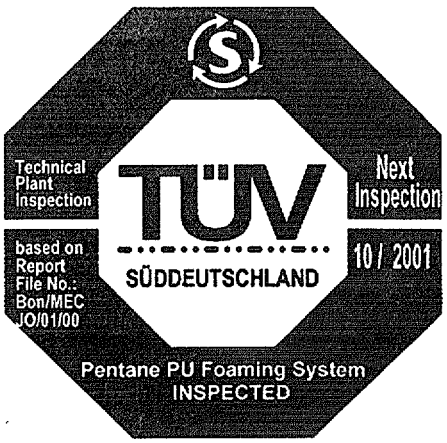
Subject: **Pentane-PU Foaming System**
Refrigerator Factory
UNIDO-Project No 97 / 097

Producer: **Cannon Afros, Italy**

Operated: **Middle East Complex**
Amman Industrial City
Amman, JORDAN

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 April to October 1998.
This Certification is based on Report on Technical Plant Inspection and Evaluation of MEC Project
TÜV BB-ULM-Ri/Be
File No.: Bon/MEC-JO/01/00

This Certification is valid until 30-10-2001



Ulm, Mai 11, 2000
TÜV Süddeutschland experts

K-J Richardt H-J Berger

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