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FINAL REPORT

on Technical Plant Inspections and Evaluations

IBERNA - CAIRO / EGYPT

Bau und Betrieb

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- Plant inspections and evaluations on location
April 1998 - Preparation of commission list
- Meeting on Bono Sistemi
July 1998 - Final inspection on location
October 1998 - Preparation of Final Commissions list
April 1999 - Preparation of Final Report

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1. OBJECTIVE AND SCOPE OF THE PLANT EVALUATION

The Iberna International Co. For Industrialisation & Appliance, Desert Road, Cairo, Egypt 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 A1 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 inspection.

The results of this inspections are reported in following documents:

Commission List

on Technical Plant Inspection and Evaluations IBERNA- Cairo/Egypt

File No.: IBERNA-EG/01/98-Ibercom1, Rev. 0, 17 July 1998

Final Commission List

on Technical Plant Inspection and Evaluations IBERNA- Cairo/Egypt

File No.: IBERNA-EG/03/98-Ibercom5, Rev. 2, 16 November 1998

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

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

During the meetings after the inspection in Iberna the responsible people of the Iberna 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 Iberna 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 Iberna.

We got that confirmations:

- From Iberna dated 15 March 1999
- from Bono Sistemi dated 18 January and 29 March 1999

After receiving this confirmations we establish, that not all pending points could be solved. In our opinion the mentioned unsolved pending points are not dangerous safety problems, but they have to be solved to get a safety Certificate for the plant.

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, from 29.04.97.
- b) Documentation about A System 100 Penta Basic Twin
 - Documentation about Multi 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 ISPEL 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
- e) The revision of 12. March 1998 of the inspection book

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 triggered 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

Iberna 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 647 16686 SA 003). These tank will be 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	Al	< - 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		Remarks
		yes	no	
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 test		x		
5. 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	x x	see Commiss. List for deviation see Commiss. List for deviation
7. Ground resistance / potential equalisation - total plant	≤ 0.1 ohm	x x		see Commiss. List
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
12. Filling Pump - switch off system			x	Commiss. List

3.2.5 Deficiencies detected / action required

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

3.3 Premix/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 belonging to the layout No. 647 166 83 SD 00B.

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, premixunit 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 after the second inspection

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
1. Gas warning system - 20% LEL - 40% LEL - system error		x x x		
2. Pentane emergency pushbutton		x		
3. Remote signals guard room			x	see Commiss. List
4. Exhausting system - pressure switch - test smoke - functions 20% LEL/40% LEL/emergency pushbutton / circuit switch	foaming mach. O.K.	x x	x	see Commiss. List
5. Leakage system - basins - pumps		x x		
6. Polyol / C 5 tank - supermax - N ₂ -min - electrical heating		x x	x	see Commiss. List see Commiss. List
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	see Commiss. List
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 - time monitoring - flow monitoring - quality of inertisation (position monitoring)		x x	x x	see Commiss. List see Commiss. List
13. Further functional tests				see Comiss. List

3.3.5 Deficiencies detected /action required

The deficiencies detected during inspection of the wetparts and the foaming machines and the measures have 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 IBERNA Factory, UNIDO Project No. 96/033 took place.

IBERNA and Bono Systemi 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 Lists mentioned in Chapter 2.1 has been fulfilled except the pending points mentioned in the letter from Iberna from 15 March 1999.

Now the above mentioned plant fulfill the most important safety standards and the requirements of the TÜV Süddeutschland Branch Ulm experts, but because there are some deficiencies to reduce the danger of fire and explosion because of using c-Pentane to a possible minimum a certificate presently can not be issued.

The Iberna Company, Cairo, Egypt will get a safety certificate for the above mentioned plant in case all pending points are solved.

The experts

signed
K.-J. Richardt

signed
E. Mack