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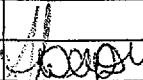
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22538



  SISTEMI	PLANT	PHASING OUT OF ODS AT REFRIGERATOR PLANT OF CHANGSHU REFRIGERATOR EQUIPMENT WORKS (BAIXUE) - CHINA
	CUSTOMER CONTRACT N. JOB N.	UNIDO FOR BAIXUE UNIDO 98/017 PROJECT MP/CPR/97/183 2298220110

PHASING OUT OF ODS AT REFRIGERATOR PLANT OF CHANGSHU REFRIGERATOR EQUIPMENT WORKS (BAIXUE)

FINAL REPORT

D					
C					
B					
A	05/03/01	FIRST ISSUE	A. LONGONI		
Rev.	Dat	Description	Prepared	Controll.	Approv.



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

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1. INTRODUCTION

With this document Contractor is going to describe the works performed at the plant site for the conversion of Changshu Refrigerator Equipment Works (Baixue) to phase out ODS in the production of Domestic Refrigerators and Freezers.

Hereafter we briefly summarise the activities performed under the Contract according to the Term of Reference

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2- VISIT TO THE PROJECT SITE AND LAY OUT OF THE PLANT (STEPS 1, 2 OF THE TERMS OF REFERENCE)

After the award of the order, the Contractor visited the Counterpart between October 5th and 7th 1998 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 Units, the Polyol and Isocyanate Modules, Safeties of the plant (as i.e.: gas sensors, exhaust system with fan groups), cyclopentane storage tanks and relevant accessories.

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

Regarding the C5 storage tanks, the Contractor inspected and defined the areas where they had to be placed.

After the visit the Contractor prepared the first progress report (December 1998) including the preliminary layout 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.

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3 TECHNICAL SPECIFICATION AND ENGINEERING DESIGN FOR THE PLANT ERECTION- TRAINING ABROAD OF THE COUNTERPART (STEPS 3÷11 OF THE TERMS OF REFERENCE)



In April 1999 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 tanks 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 in the later period.

A team of engineers attended the training at Contractor site in March 1999

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4. DELIVERY OF EQUIPMENT, INSTALLATION, COMMISSIONING, TRIAL PRODUCTION OF THE FIRST MODELS, TEST RUN OF PRODUCTION(STEPS 12÷15 OF THE TERMS OF REFERENCE)

In June 1999 all the new equipment have been shipped.

The installation started in September 1999, after the customs clearance of all the equipment.

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

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




- Cyclopentane storage tanks areas
- Wet areas
- Process fluid connection piping between wet and dry area
- Cabinets /doors foaming areas
- Safeties of the plants (ventilation system, fire fighting system et cetera)

The installation phase was completed in May 2000.

After the installation, the Contractor performed the Commissioning and start-up phase of the modified plant in accordance with the contract.

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

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The training on the job activities has been carried out at the beginning of commissioning phase (May 2000)

In July 2000 the commissioning phase was completed on Plant 1 and Plant 8, while on Plant 2 & 3 it was completed in October 2000 and the Counterpart started the production of the first models of freezers with cyclopentane as blowing agent.

The Counterpart signed the final acceptance certificate in October/November 2000 (enclosure A).




5. TRAINING ON THE JOB, SAFETY INSPECTION AND CERTIFICATION, FINAL REPORT, POST CONTRACT MONITORING ACTIVITIES (STEPS 16÷19 OF THE TERMS OF REFERENCE)

The training on the job activities has been carried out at the beginning of commissioning phase (May 2000)

The safety inspection has been performed by TUV ULM in July 2000 on Plant 1 and Plant 8, in November 2000 on Plant 2 and Plant 3; enclosed please find the TUV final reports (enclosure B).



The post contract monitoring activities have started in May 2000 and will end at the end of March 2001

TUV original certificate is enclosed in this document (enclosure C).



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6. ENCLOSURES

- A) ACCEPTANCE CERTIFICATE
- B) TUV FINAL REPORT
- C) TUV CERTIFICATE

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A

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B

Cannon

ENVIRONMENTAL TECHNOLOGIES AND SYSTEM ENGINEERING

BONO

Energy & Ecology

Bono Sistemi S.p.A.

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Partita IVA e Cod. Fisc. IT 10467110150 - Cap. Soc. L. 1.500.000.000 LV.

SISTEMI

DATE: 06/11/2000

COMMISSIONING ACCEPTANCE OF UNIDO PROJECT N. MP/CPR/97/183
CONTRACT N. 98/017
PLANT №3

SUPPLIER: CANNON

BY THIS DOCUMENT CHANGSHU REFRIGERATOR EQUIPMENT WORKS (BAIXUE)
ACKNOWLEDGES THAT CANNON/BONO SISTEMI HAS SATISFACTORILY
COMPLETED THE COMMISSIONING OF THE PROJECT

DATE

CHANGSHU REFRIGERATOR
EQUIPMENT WORKS (BAIXUE)

2000. 11. 6

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SISTEMI

DATE: 27/10/2000

COMMISSIONING ACCEPTANCE OF UNIDO PROJECT N. MP/CPR/97/183
CONTRACT N. 98/017
PLANT No 1

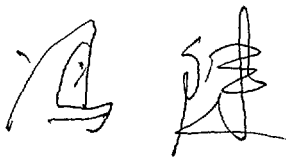
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SISTEMI

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CONTRACT N. 98/017
PLANT No8

SUPPLIER: CANNON

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SISTEMI

DATE: 06/11/2000

COMMISSIONING ACCEPTANCE OF UNIDO PROJECT N. MP/CPR/97/183
CONTRACT N. 98/017
PLANT No2

SUPPLIER: CANNON

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ACKNOWLEDGES THAT CANNON/BONO SISTEMI HAS SATISFACTORILY
COMPLETED THE COMMISSIONING OF THE PROJECT

DATE

CHANGSHU REFRIGERATOR
EQUIPMENT WORKS (BAIXUE)

CANNON/BONO SISTEMI

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2000.10.30

**Report
of the safety Inspection
of the CFC-conversion of Baixue Factory 1 and 8**

**Bau und
Betrieb**

Plant Location: **Baixue**
Changshu Refrigerating Equipment Works
149 Huayuanbang Road
Changshu, Jiangsu, P.R.China

Niederlassung Ulm

Plants:

- **Factory 1**
 - C-5 Storage area
 - Pre-mix – Intermediate tank-area
 - Cabinet Line A
 - Cabinet Line B
 - Door Line C („Safety Doors“)
- **Factory 8**
 - C-5 Storage area
 - Pre-mix area
 - Door line

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Internet: www.tuevs.de
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Project: Conversion of the Freezer and Refrigerator
Plants with Pentane as blowing agent

Ulm, 2001-02-13
TÜV-BB-Ulm/Ri-Ma
Bon-Bai1+8-PRC-02-01-FinalreJ
Word 97

UNIDO-Project: MP/CPR/97/183
TÜV-ORDER No.: 200 368 097

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

TÜV-Experts: Karl-Josef Richardt - TÜV-BB-ULM, Dep. NDD
Eberhard Mack - TÜV-BB-ULM, Dep. NEG

Data:

- 26th - 29th July 2000
 - Inspection of the plants at Baixue
- August / September 2000
 - Preparation of Report
- February 2001
 - Final Report

Seite 1 von 48

File: Bon/Bai1+8/PRC/02/0'

Participants:

Mr. Longoni	Bono Sistemi
Mr. Soh Boon Wah	Cannon Fare East
Mr. Chia Sher Lia	Cannon Fare East
Mr. Feng Jian	Baixue
Mr. Lu Chen	Baixue

Report is sent to: Bono Sistemi Mr. Longoni
UNIDO, Mr. Grof

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1. OBJECTIVE AND SCOPE OF THE PLANT EVALUATION

The Baixue Company in Changshou, P.R. China 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 hazard class A1. 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.

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

The final inspection took place from 26th to 29th July 2000.

The results of this inspection are mentioned in this report.

The items were discussed with representatives of Bono/Cannon and Baixue during the mission of TÜV in Changshu P.R.China.

The most deficiencies and measures, came up during the inspection were solved by technicians of Cannon and Baixue. The solved deficiencies were inspected on the last day again.

The deficiencies mentioned in this report must be solved by Bono/Cannon and Baixue and the solution must be stated to the signed experts.

During the inspection in October 2000 for plant 2+3 the experts investigated the solved deficiencies of plant 1 and 8 and made relevant measures.

With letter of 11th January 2001 Bono confirmed that all pending points mentioned in the draft report has been solved.

This was also stated with Memorandum of 11th January 2001 by Cannon and Baixue.

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 (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 Cannon/Bono was delivered in September 2000 and was available on site during the inspection.

The documentation included:

- a) Documentation for all Baixue plants (1,2,3,8) (2 files drawing)

No.: 2298 22011

included relevant drawings for installation

Plant 1:

- b) Foam machine Factory 1 line A

Type A 100 PT No.: 29 10 08; Year 1999

- c) Foam machine Factory 1 line B

Type PM 100 Twin No.: 29 10 09; Year 1999

- d) Foam machine Factory 1 line C

Type PM 100 Twin No.: 29 12 19; Year 1999

- e) Mixing unit

Penta Easy Froth 20+4 No.: 55 06 83 Year 1999

- f) File with electrical wiring diagram year 5/2000

- g) Mechanical manual

Doc. No.: MM00/118-1-Rev.0 17/04/2000

- h) Inspection Book

Doc. No.: IB00/110-1 Rev.0 20/04/2000

Plant 8:

- h) A sys 40 PT No.: 27 12 17 year 1999
- i) Mixing unit
Penta Easy Froth 20+4 No.: 55 06 86 Year 1999
- j) File with electrical wiring diagram year 5/2000
- k) Mechanical manual
Doc. No.: MM00/118-8-Rev.0 17/04/2000
- l) Inspection Book
Doc. No.: IB00/110-8 Rev.0 20/04/2000

2.4 Documentation of Baixue

Following documentation were available

- C5-safety regulations for the security guard
- Management Regulations of C5 storage stations
- Training regulations of safety production
- Emergency procedures during C5 foaming and R600a charging
- Safety management Regulations for cfc-free production
- Instruction of unloading process C5 storage area

During the start up time several parts of these documentation must be completed and updated.

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 (%)
Cyclopentane	Al	< - 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 / C 5 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 / C 5 plant must be installed within the alarm zone.

d) 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.

e) 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 Plant 1

4.1 Parts of TÜV inspection

Following plants and equipment are part of this inspection:

- c-Pentane Tank area
- Pipe to the mixing unit
- Mixing unit and Intermediate tank area
- Cabinet area A and B
- Door plant area C

Not part of this TÜV inspection are:

- Polyol/Isocyanat-Storage areas

4.2 C 5 storage area

4.2.1 Brief description of the plant

Pentane is stored in an underground tank with a capacity of 35.000 liters.

This tank will be filled by truck.

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

The C 5 pipe to the premix room is aboveground and will be feeded by 2 red jacket pumps.

The area in which C 5 will be released in the event of 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 C 5 catch basin by a special valve.

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

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 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
 - Inside the tank pit
 - The interior of the 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 pit over a distance of 2,0 m up to a height of 0.8 m from the floor additional to the Zone 1.
- d) Fire hazard zone
 - Total C 5 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) <u>Function tests</u>				
1. Pentane emergency push button				
– pentane emergency push button (1 st level)		x		
– emergency push button (control panel)		x		
2. Alarm signals to guard room		x		
3. C 5 tank				
3.1 leakage monitoring:				
a. Double wall				
– minimum contact		x		
– maximum contact		x		
– flow of the monitoring liquid		x		
3.2 N ₂ -pressurization				
– N ₂ -low (200 mbar)		x		
– N ₂ -min (10 mbar)		x		
3.3 c5-level monitoring				
– maximum level(90 %)		x		
– super max. level (95 %)		x		
– signal (30%)		x		
– low level (10 %)		x		
4. c5-basin		x		
5. Pressure testing of pentane pipeline		x		– test was done under supervision of Cannon – test record is submitted

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
1. Electrical resistance of floor (conductivity)				
– position of tank-truck during unloading	3 - 8 kOhm	x		
– explosion dangerous area around the tank-equipment	30 - 50 kOhm	x		
2. Ground/earth resistance				
– earth resistance				
• earth system	0,7 ohm	x		
• lightning protection	0,7 ohm	x		
– Potential equalisation				
• tank equipment	≤ 0.3 ohm	x		
• truck grounding	0.1 ohm	x		
3. Conductivity				
– racking hoses	> 10 ⁶ ohm	x		
4. Electrical circuits/control panel				
– insulation resistance	≥ 30 mega ohm	x		
– over current protection	adjustments and system o.k.	x		
– over voltage protection		x		

4.2.4 Detected deficiencies and required actions

- Pentane storage area -

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
1.	<u>Remark</u>		
	The most deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time.		
	The solutions were controlled by the TÜV experts in an additional inspection.		
	All deficiencies mentioned in the draft report were solved and this were confirmed by BONO and Baixue.		
2.	<u>Electrical control panel</u>		
2.1	The protection device against the danger of over voltage (e.g. thunderstorm, mains fault) is missing.	done 4/11/00	done
	This device must be installed either in the control panel or in supply circuit of the panel.		
3.	<u>Area of c5-tank</u>		
3.1	The pits of the earthing-connections must be filled completely by sand.		done 9/1/01
3.2	The unloading are will be designed complete as a basin. This included:		done 4/11/00
	- Pit for grounding must be protected against leakages of pentane		
	- On the right side of the basin the basin need a little wall		
	- A little slope to both entries will be installed		
3.3	Operator unloading instruction		done 4/11/00
	- Point 10 no.3 Turn off discharge valve MV03 must be not included due to the pre-pressure of the truck the return line can not be opened. (this is a special solution for this company)		
3.4	Feeding line		done 4/11/00
	- This line must be fixed on the metal of the tank pit.		

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
3.5	At the cable introductions of the flameproof equipment (Ex-d) the special sealing is missing	done 4/11/00	done
3.6	For the c5-storage area an illumination is necessary		done 5/1/01
3.7	The filling and the gas return hose are electrostatic chargeable and therefor unsuitable.	done 9/1/01	

4.3 Pre-mix and Intermediate tank area

4.3.1 Brief description of the plant

The Cannon Pre-mix unit Easy Froth is used. The Easy Froth is inside an enclosure near cabinet line A. Inside the same enclosure an intermediate tank with a capacity of 1000 liters is installed.

The Pentane feeding pipe is installed over-ground. Before this pipe enters the production hall 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 Easy Froth and the Intermediate tank are installed outside the enclosure.

Further details are described in the Bono / Cannon documentation.

4.3.2 Zone Definitions and Dimensions

a) Alarm-zone

- The total enclosure of Easy Froth with intermediate tank.

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:

- Inside the intermediate tank

d) Fire danger zone

- The surrounding area of 5 m around the enclosure

4.3.3 Measurements/Function tests

- Easy Froth-Intermediate tank area
- c5-safety control panel
- Back-up generator

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
- Easy Froth/ intermediate tank area				
1. Gas warning system - 15% LEL - 30% LEL - system error		x x x		
2. Emergency push-button - pentane emergency push button (1 st -level) - Emergency push button (control panel)		x x		
3. Alarm signals to guard place		x		
4. Exhausting system - flow sensor • Easy Froth • Room ventilation - test smoke - functions 15 % LEL	o.k.	x x x x		
5. Leakage sensor - Basin buffer tank - Easy Froth Sensor 1 - Easy Froth Sensor 2		x x x		
6. Buffer tank - N ₂ min tank - Super max. level control - Safety Thermostat - Safety relief valve tank		x x x x		- Pmin=1bar - Stop Easy Froth - Manual reset on control panel - ISPEL
7. Exit lamps (battery)		x		
8. Fire fighting system - Thermo sticks - Sprinkler system		x x		
9. Leakage control system - c5/polyol feeding pump		x		
10. Door monitoring - doors of Easy Froth - doors of room		x x		
11. Increase of alarm levels - increase from 3rd to 2nd level alarm - increase from 2nd to 1st level alarm		x x		
12. P-max. control - Easy froth - c5/polyol feeding pipe		x x		

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
B) Measurements Easy froth / intermediate tank area				
1. Electric resistance of floor (conductivity) – floor in the room	0,6 - 1,0 mega ohm	x		
2. Ground/earth resistance – earth resistance • earth system • lightning protection (ventilation system) – Potential equalisation • Easy Froth/Buffer tank Tank • plant equipment (pipes, ventilation channels)	0.7 ohm 0.7 ohm ≤ 0.3 ohm ≤ 0.3 ohm	x x x x		– additional necessities were carried out during inspection
3. Electrostatic field strength – enclosure of Easy Froth – windows of the room-enclosure – insulation of tank, pipes etc.	0 kV/m 0 kV/m 0 kV/m	x x x		– grounded bars are mounted on the windows
4. Electrical circuits/control panels – Insulation resistance – over current protection	30 mega ohm adjustment o.k.	x x		
5. Exhausting system – Fan pre-mix area – Easy Froth	– speed 1: 8,0 m/s – speed 2: 10,0 m/s – speed 1: 9,0 m/s – speed 2: 10,0 m/s	x x		

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
C) c5-safety control panel				
1. Function tests – monitoring of circuit breakers and fuses – push button for testing of signalling – supply by UPS		x x x		
2. Presence and adjustment-control – timer relays over current – protection device – over voltage protection device		x x x		
3. Measurements – circuits-insulation	≥ 30 M ohm	x		
D) Back-up Generator				
1. Function tests – running without load – running with load – automatic start in case of power failure		x x x		- the switch over unit didn't work therefore an exchange of this gear was necessary

4.3.4 Detected deficiencies and required actions

- Easy Froth / intermediate tank area
- c5-safety control panel
- Back-up generator

		Responsible BO = Bono/Cannon Bai = Baixue	
		BO	Bai
1.	<p><u>Remark</u></p> <p>The most deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time. The solutions were controlled by the TÜV experts in an additional inspection.</p> <p>All deficiencies mentioned in the draft report were solved and this were confirmed by BONO and Baixue.</p>		
2.	<p><u>Intermediate tank</u></p> <p>The safety relief valve must be tight (test at 9 bar) Install with Oring and fightern.</p>	done	9/1/01
3.	<p><u>Easy Froth</u></p>		
3.1	<p>The blend pipe at the exit of the Easyfroth should be a rigid pipe but in any case the pipe must be protected against mechanical stress.</p>		done 4/11/00
3.2	<p>N₂-supply for the automatic valves: The N₂-supply for the automatic valves presently is connected temporary with N₂-cylinders. The final solution would be a connection with N₂-generator.</p>		done 12/1/01
4.	<p><u>Organisation matters</u></p> <p>The safety matrix must be completed</p> <ul style="list-style-type: none"> - intermediate tank - Pmax of blend feeding line - flow switch 	done 2/11/00	

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
5	<u>Pentane safety panel:</u>		
5.1	The protection device against the danger of over voltage (e.g. thunderstorm, mains fault) is missing. This device must be installed either in the control panel or in supply circuit of the panel.	done 4/11/00	done
5.2	The new installed voltage-stabilizer is not drawn in the electrical diagram.	Bono done see letter of 15/11.00	
5.3	The cables and wires used for grounding have to be marked green-yellow.		done 4/11/00
6.	<u>Back up generator</u>		
6.1	A lighting which is supplied by a circuit of the backup generator is necessary in the room with the generator and with the remote alarm panels.		done 4/11/00
6.2	The area where the cables are introduced into the control panel must be closed (IP 54)		done 4/11/00
7.	<u>Ventilation system</u>		
7.1	The automatic moveable flaps on the fan-enclosure were not in correct order. This must be repaired and the measurements of the airspeed in the channels must be done again.		done 9/1/01
7.2	The moveable flaps along the ventilation channels must be secured against changes by unauthorised persons.		done 9/1/01
8.	<u>Sprinkler system</u>		
8.1	Electrical control panel: At the inner side of the panel door a coverplate over the electrical devices is missing.		done 9/1/01
9.	<u>Power distribution panel</u>		
9.1	At the inner side of the panel door a coverplate over the electrical devices is necessary		done 7/11/00

4.4 Cabinet Line A + B and Door plant C („Safety Doors“)

4.4.1 Brief description of the plants

The cabinet line A + B consists at a PU foaming machine Type PM 100 Twin and the door line the Type 40 P.T. which are in enclosures. The dry parts are carousels with movable jigs. The door part are 6 fixtures which are in a half circle in a special enclosure.

The machine supplied the mixing heads of the plants.

The jigs are heated in an oven which is supplied by a steam heater.

The pipes to the mixing head are on a pipe bridge. As connection cutting rings are used.

Before the foam injection the cabinet and also doors will be filled with nitrogen.

More details are in the Cannon/Bono documentation.

4.4.2 Zone definitions and dimensions

a) Alarm zone

- The interior of the cabin with the wet part
- The interior of the enclosure with the dry part.

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 polyol / C 5 tanks
- The interior of the refrigerator cabinets and the „Safety doors“ after flushing by nitrogen

d) Fire hazard zone

A surrounding of 5 m around the wet-part and the dry-part.

4.4.3 Measurements / Function tests

– Cabinet line A + B and Door plant

- 2-foaming machines, Typ 40 P.T. and 100 P.T. (wet parts)
- Cabinet plants A + B and Door plant C (dry parts)

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
A) <u>Function tests</u>				
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				
• Cabinet wet part		x		
• Door wet part		x		
• Door dry part		x		
• Cabinet A Dry part		x		
• Cabinet B Dry part		x		
– test smoke		x		
– functions 15 % LEL		x		
5. Leakage system				
– basin wet part		x		
– pump wet part		x		
– stirrer tank wet part		x		
– stream distributor dry part		x		
6. Polyol / C5 tank				
– Super max		x		
– N ₂ -min		x		
– Safety thermostat		x		
7. Door monitoring wet part / dry part		x		

– not function-coupled with Easy Froth because two automatic valves at incoming pipe

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
8. Fire fighting system - Thermo sticks - Sprinkler system		x x		
9. Increase of alarm levels - increase from 3 rd to 2 nd level alarm - increase from 2 nd to 1 st level alarm		x x		
10. N ₂ -inertisation of cabinet and doors - N ₂ -pressure monitoring - N ₂ -flow monitoring		x x		
B) Measurements				
1. Electrical resistance of floor (conductivity) - 1.00 m surrounding of foaming machine - dry part	270 - 400 kOhm 15 - 30 kOhm partly > 1,5 mega ohm (solved)	x x		
2. Ground/earth resistance - earth resistance • earth system • lightning protection (ventilation system) - Potential equalisation • foaming machines • dry part plants • jigs • mixing heads	0,7 ohm 0,7 ohm ≤ 0.3 ohm ≤ 0.3 ohm 0.3 ohm 0.3 ohm	x x x x x x		
3. Electrostatic field strength - enclosure of foaming machines - window of the dry part - Insulation of tank, pipes etc.	0 kV/m 0 kV/m max. 5.0 kV/m	x x x		- grounded bars are mounted on the windows
4. Electrical circuits / control panels - insulation resistance - over current protection	≥ 30 mega ohm (0,8 mega ohm tank. Heater door plant) o.K.	x x	x	

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
5. Exhausting system				K 103 / A and B
- Fan Cabinet area (Dry part (B2/B3))	- speed 1: 9 m/s - speed 2: 10 m/s	x x		
- Fan Door area Wetpart (C1)	speed 1: 7 m/s - speed 2: 9 m/s	x x		
- Fan Door area Drypart (C2)	speed 1: 10 m/s - speed 2: 13 m/s	x x		
- Fan Door area Drypart (C3)	speed 1: 10 m/s - speed 2: 14 m/s	x x		
6. Inertisation				
- flushing time	- as automatic calculated	x		- depends on amount of foam
- O ₂ concentration line A				- < 11,1 % O ₂
- O ₂ concentration line B	- 5,1% O ₂	x		- < 11,7 % O ₂
- O ₂ concentration line C	- ≈ 6 % O ₂	x		- < 11,7 % O ₂

4.4.4 Detected deficiencies and required actions

- Cabinet Line A + B and Door plant
 - Foaming machines, typ A 40 P.T. (Door) and A 100 P.T. (Cabinet A + B)
 - Cabinet plants A and B (dry parts)
 - Door plant („Safety doors“)

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
1.	<u>Remark</u> The most deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time. The solutions were controlled by the TÜV experts in an additional inspection. All deficiencies mentioned in the draft report were solved and this were confirmed by BONO and Baixue.		
2.	<u>Dry part line A</u>		
2.1	Conveyor-Motor: The introduction of the cable into the motor-connection box must be carried out in a professional way. (motor design: Ex-d)		done 9/1/01
2.2	Area under the operator floor: a) The big amount of waste (polyol, isocyanate, foam) must be removed. A regularly cleaning of this area has to be organised. b) The sockets have to be removed in the dry part area (alarmzone) c) The cables have to be attached an installed in a better way.		done 9/1/01 done 9/1/01 done 9/1/01
3	<u>Dry part cabinet line B</u>		
3.1	Place for pouring and foam rising: The effectiveness of the ventilation in this place must be improved. For this the position of the ventilation channel will be changed.		done 4/11/00
3.2	The electrical cables on the floor must get a protection against mechanical stress.		done 9/1/01

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
3.3	The floor in the operator-area is very dirty through that the electrical resistance (conductivity) is too high. The floor has to be cleaned now and regularly.		done 9/1/01
4	<u>Wetparts</u>		
4.1	Pipes		
	a) The screws of the SEA flanges are partly to short.	done 9/1/01	
	b) From the intermediate tank to the day tanks the pipes are installed on the wet part cabin. In this area the pipe must be always visible and regularly inspected.	done 9/1/01	
4.2	All exits of pipes must be closed additional to the valve with a blind screw.	done 9/1/01	
4.3	Room with the wet part of line B:		
	a) A lamp which is supplied from a circuit of the back up generator must be installed there.		done 9/1/01
	b) Entrance area to this room: The technicians of Baixue have planned to remove the old electrical panel. This planning should be realised very soon.		done 4/11/00
4.4	Wet part of line B:		
	a) A solenoid valve at the pipe of the chiller ist positioned inside the wet part enclosure. In case of the 1 st level alarm this solenoid valve must be deenergized by the automatic shut down function.	done 4/11/00	done 4/11/00
	b) The siren for fault signalling is missing yet.	done 9/1/01	
4.5	Room with the wet part of line A: A lamp which is supplied from a circuit of the backup generator must be installed there.		done 9/1/01
5.	<u>Door plant („Safety doors“)</u>		
5.1	Wet part		
5.1.1	A lamp which is supplied from a circuit of the back up operator must be installed in the room..		done 9/1/01
5.1.2	The condition of the fuse-box, which is placed near by the wetpart, must be improved (use of sealings, cable introduction, wiring)		done 9/1/01
5.1.3	The lamp above the wet part has to be connected in a professional way.		done 4/11/00

	Responsible	
	BO	Bai
5.1.4 The N ₂ -supply presently is carried out in a temporary way by N ₂ -cylinder. The final solution will be a N ₂ -supply by the nitrogen generator		done 9/1/01
5.1.5 The siren for the fault signalling is missing yet.	done 9/1/01	
5.1.6 Electrical heating on the tank: The result of the measured insulation resistance is at the minimum limit (testing result: 0,8 mega ohm). This measurement must be done again after the heating has worked some hours. If the insulation resistance is improved after that (e.g. 1,0 mega ohm) the wetness is the reason for the low resistance. Otherwise a fault on the heating device is the reason and must be changed.	done 9/1/01	
5.1.7 Pentane safety control panel:		
a) The protection device against the danger of over voltage (e.g. thunderstorm, mains fault) is missing	done 4/11/00	
b) The new installed voltage-stabilizer is not drawn in the electrical diagram	Bono done see letter of 15/11/00	
5.2 <u>Dry part</u>		
5.2.1 Pipe-distribution unit: The tray-detector is without function because the sealing on the distribution unit is damaged. (the monitoring circuit is bridged in the control panel)	done 9/1/01	
5.2.2 Flexible ventilation-hoses: The metallic spiral at the hoses must be grounded in avoidance an electrostatic charge.		done 9/1/01
5.2.3 Thermostick-firedetector: For the cable introduction the Ex-d-fitting is missing.	done 9/1/01	
5.2.4 Doors in the enclosure:		
a) At the inside of the doors (escape-way-direction) handels to open the door are missing.		done 9/1/01
b) The warning signs (e.q. fire- and explosion hazardous area) at the entrance doors are missing yet.	done 9/1/01	
5.2.5 Channel within the floor: The not used channel most be filled up with sand or covered gas-tight		done 9/1/01

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
5.2.6	The attachment of the mixing head isn't completely finished yet.	done 4/11/00	done 4/11/00
6.	<u>Inertisation system</u>		
6.1	N ₂ -Generator and tank		
a)	The N ₂ concentration of the generator must be adjusted > 95%.	done 9/1/01	
b)	The nitrogentank must be fixed on the floor. The tank must be protected against mechanical stress e.g. forklifts.	done 9/1/01	
c)	In the formula of the software of the inertisation system the purity of the N ₂ is not included.	done 9/1/01	
6.2	Inertisation for cabinets and doors		
	The inertisation of the Line B was not in function because the range of the flowmeter was to little.	done 9/1/01	
7	<u>Ventilation system</u>		
a)	The automatic moveable flaps within the fan enclosure were not in correct order. This must be repaired and the measures of the airspeed in the channels must be done again.	done 9/1/01	
b)	One motor of the ventilation system plant A was out of order and must be changed.	done 9/1/01	
8	<u>Water Sprinkler system</u>		
a)	During the inspection the sprinkler system has been improved, but could not be tested. A kind description of the system is necessary.		done 4/11/00
b)	The handles (wheels) on the manual valves must be removed or secured against usage by unauthorised persons.		done 4/11/00
9	<u>Power distribution panels</u>		
	The function coupling between the 1 st level alarm and the power-shut down is realised via relays without safety function approval. The relevant relays in the power distribution panels have to be exchanged by safety function relays.		done 4/11/00

5. Results of inspection and evaluation Plant 8

5.1 Parts of TÜV inspection

Following plants and equipment are part of this inspection:

- c-Pentane Tank area
- Pipe to the mixing unit
- Mixing unit
- Door plant area (carriage)

Not part of this TÜV inspection are:

- Polyol/Isocyanat-Storage areas

5.2 c5-storage area

5.2.1 Brief description of the plant

Pentane is stored in an underground tank with a capacity of 5.000 liters. This tank will be filled by truck.

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

The C 5 pipe to the premix room is aboveground and will be feeded by a red jacket pump.

The area in which C 5 will be released in the event of leakage during the filling process is designed as a liquid catch basin.

Water gutters are structurally separate from the catch basin.

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

5.2.2 Explosion zones / fire hazard zone

The definitions and dimensions described in chapter 4.2.2 are valid also here

5.2.3. Measurements / safety functional tests - Pentane storage area-

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
A) <u>Function tests</u>				
1. Pentane emergency push button				
– pentane emergency push button (1 st level)		x		
– emergency push button (control panel)		x		
2. Alarm signals to guard room		x		
3. C 5 tank				
3.1 leakage monitoring:				
a. Double wall				
– minimum contact		x		
– maximum contact		x		
– flow of the monitoring liquid		x		
3.2 N ₂ -pressurization				
– N ₂ .low (200 mbar)		x		
– N ₂ -min (10 mbar)		x		
3.3 c5-level monitoring				
– maximum level(90 %)		x		
– super max. level (95 %)		x		
– signal (30%)		x		
– low level (10 %)		x		
				Requirement of the red jacket pump approval both pumps stops
4. c5-basin		x		
5. Pressure testing of pentane pipeline		x		– test was done under supervision of Cannon – test record is submitted

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
1. Electrical resistance of floor (conductivity)				
– position of tank-truck during unloading	6-10 kOhm	x		
– explosion dangerous area around the tank-equipment	6-10 kOhm	x		
2. Ground/earth resistance				
– earth resistance				
• earth system	0,7 ohm	x		
• lightning protection	0,7 ohm	x		
– Potential equalisation				
• tank equipment	≤ 0.3 ohm	x		
• truck grounding	0.1 ohm	x		
3. Conductivity				
– racking hoses	> 10 ⁶ Ohm	x		
4. Electrical circuits/control panel				
– insulation resistance	≥ 30 mega ohm	x		
– over current protection	adjustments and system o.k.	x		
– over voltage protection		x		

5.2.4 Detected deficiencies and required actions

- Pentane storage area -

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
1.	<u>Remark</u> The most deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time. The solutions were controlled by the TÜV experts in an additional inspection. All deficiencies mentioned in the draft report were solved and this were confirmed by BONO and Baixue.		
2.	<u>Electrical control panel</u>		
2.1	The protection device against the danger of over voltage (e.g. thunderstorm, mains fault) is missing. This device must be installed either in the control panel or in supply circuit of the panel.	done 10/1/01	done 10/1/01
3.	<u>Area of c5-tank</u>		
3.1	For the c5-Storage are an illumination is necessary. The existing lamp is installed provisionally only; that means a final installation must be done.		done 10/1/01
3.2	The filling and the gas return hose are electrostatic chargeable and therefor unsuitable.	done 10/1/01	

5.3 Pre-mix and Intermediate tank area

5.3.1 Brief description of the plant

The Cannon Pre-mix unit Easy Froth is used. The Easy Froth is inside an enclosure near the door line.

The Pentane feeding pipe is installed over-ground. Before this pipe enters the production hall 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 Easy Froth are installed outside the enclosure.

Further details are described in the Bono / Cannon documentation.

5.3.2 Zone Definitions and Dimensions

a) Alarm-zone

- The total enclosure of Easy Froth

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) Fire danger zone

- The surrounding area of 5 m around the enclosure

5.3.3. Measurements / safety functional tests

- Easy Froth
- c5-safety control panel
- Back-up generator

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
- Easy Froth/ intermediate tank area				
1. Gas warning system - 15% LEL - 30% LEL - system error		x x x		
2. Emergency push-button - pentane emergency push button (1 st -level) - Emergency push button (control panel)		x x		
3. Alarm signals to guard place				
4. Exhausting system - flow sensor • Easy Froth - test smoke - functions 15 % LEL		x x x		
5. Leakage sensor - Easy Froth Sensor 1 - Easy Froth Sensor 2		x x		
6. Exit lamps (battery)		x		
7. Fire fighting system - Thermo sticks - Sprinkler system		x x		
8. Leakage control system - c5/polyol feeding pump		x		
9. Door monitoring - doors of Easy Froth - doors of room		x x		
10. Increase of alarm levels - increase from 3rd to 2nd level alarm - increase from 2nd to 1st level alarm		x x		
12. P-max. control - Easy froth - c5/polyol feeding pipe		x x		

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
B) Measurements – Easy froth				
1. Electric resistance of floor (conductivity) – floor in the room	10-20 kOhm	x		
2. Ground/earth resistance – earth resistance <ul style="list-style-type: none"> • earth system • lightning protection (ventilation system) – Potential equalisation <ul style="list-style-type: none"> • Easy Froth/Buffer tank • plant equipment (pipes, ventilation channels) 	0,5 ohm 0,5 ohm ≤ 0,3 ohm ≤ 0,3 ohm	x x x x		
3. Electrostatic field strength – enclosure of Easy Froth – windows of the room-enclosure – insulation of tank, pipes etc	0 kV/m 0 kV/m 5 kV/m	x x x		-grounded bars ar mounted on the windows
4. Electrical circuits/control panels – Insulation resistance – over current protection	≥ 30 mega ohm ok	x x		
5. Exhausting system – Easy Froth	– speed 1: 6,0 m/s – speed 2: 6,4 m/s	x x		
C) c5-safety control panel				
1. Function tests – monitoring of circuit breakers and fuses – push button for testing of signalling – supply by UPS		x x x		
2. Presence and adjustment-control – timer relays over current – protection device – over voltage protection device		x x 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				
1. Function tests				
- running without load		x		
- running with load		x		
- automatic start in case of power failure		x		

5.3.4 Detected deficiencies and required actions

- Easy Froth / Intermediate tank area
- c5-safety control panel
- Back-up generator

		Responsible BO = Bono/Cannon Bai = Baixue	
		BO	Bai
1.	<u>Remark</u> The most deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time. The solutions were controlled by the TÜV experts in an additional inspection. All deficiencies mentioned in the draft report were solved and this were confirmed by BONO and Baixue.		
2.	<u>Pentane Safety panel</u>		
2.1	The protection device against the danger of over voltage (e.g. thunderstorm, mains fault) is missing. This device must be installed either in the control panel or in supply circuit of the panel.	done 10/1/01	done 10/1/01
2.2	The new installed voltage-stabilizer is not drawn in the electrical diagram	Bono done see letter of 15/11/00	
3.	<u>Ventilation system</u> The automatic removable flap inside the ventilation did not work correctly. Therefore the second speed was not in order. After the system is in order a new measurement must be done	x	done 4/11/01
4.	<u>Easy Froth</u>		
4.1	<u>Blend pipe from Easy froth</u> The blend pipe which is connected with the Easy troth is only glued. Bono/Cannon has to prove that this connection is sufficient.	done 4/11/00	
4.2	N2-cylinders: The nitrogen cylinders must be fixed		done 10/1/01

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
5.	<u>Back up generator</u>		
5.1	<u>Control panel</u>		
	a) The area of the cable-introduction has to be close according to the requirement of protection.		done 10/1/01
	b) For the wires outside the control panel the usage of channels or conduits is required.		done 10/1/01
5.2	The lighting in the room is installed provisionally only. An improvement is necessary there.		done 10/1/01
6.	<u>Water sprinkler system</u>		
6.1	The pressure gauge on the sprinkler pump has to be exchanged for a pressure gauge with electrical minimum / maximum contacts.		done 10/1/01
7.	<u>Power distribution panel</u>		
7.1	The function coupling between the 1 st level alarm and the power-shut down is realised via relays without safety function approval. The relevant relays in the power distribution panels have to be exchanged by safety function relays.		done 10/1/01
7:2	Connection bar: The connection of the neutral and ground wires at the connection bar have to carried out in a professional way (use of lugs, spring washer)		done 10/1/01
7.3	The area of the cable-introduction has to be closed according to the requirements of protection (IP 54)		done 10/1/01

5.4 Door Line

5.4.1 Brief description of the plants

The door line uses a machine of the Type A sys 40 Penta Twin which is in an enclosure. The dry parts are carousels with movable jigs in a enclosure. There is one part for heating only and one part where the pouring takes place.

The machine supplied the mixing head of the plant.

The jigs are heated in an oven which is supplied by a steam heater.

The pipes to the mixing head are on a pipe bridge. As connection cutting rings are used.

The pipes to the day tank are welded.

An inertisation system for the doors is not used. The nitrogen-generator together with the tank is only designed and used to supply the day tank.

5.4.2 Zone Definitions and Dimension

The definitions and dimensions described in chapter 4.4.2 are valid also here.

5.4.3 Measurements / Function tests

- Door plant
 - Foaming machine, Typ 40 P.T. (wet part)
 - Door plant (dry parts)

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
1. Gas warning system <ul style="list-style-type: none"> – 15 % LEL – 30 % LEL – System error 		x		
2. Emergency push-button <ul style="list-style-type: none"> – pentane emergency push button (1st level) – emergency push button (control panel) 		x		
3. Alarm signals to guard place		x		
4. Exhausting systems <ul style="list-style-type: none"> – flow sensor <ul style="list-style-type: none"> • Door wet part • Door dry part – test smoke – functions 15 % LEL 		x		
5. Leakage system <ul style="list-style-type: none"> – basis wet part – pump wet part – stirrer tank wet part 		x		
6. Polyol / C5 tank <ul style="list-style-type: none"> – Super max – N2-min – safety thermostat 		x		
7. Door monitoring wet part / dry part		x		
8. Fire fighting system <ul style="list-style-type: none"> – Thermo sticks – Sprinkler system 		x		
9. Increase of alarm levels <ul style="list-style-type: none"> – increase from 3rd to 2nd level alarm – increase from 2nd to 1st level alarm 		x		
10. N ₂ -inertisation of day tank <ul style="list-style-type: none"> – N2-pressure monitoring 		x		

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
1. Electrical resistance of floor (conductivity)				
– 1.00 m surrounding of foaming machine	20 - 25 k Ohm	x		
– dry part	10 - 15 k Ohm	x		
2. Ground/earth resistance	0,5 Ohm			
– earth resistance	0,5 Ohm			
• earth system		x		
• lightning protection (ventilation system)		x		
– Potential equalisation				
• foaming machines		x		
• dry part plants	≤ 0.3 Ohm	x		
• jigs	≤ 0.3 Ohm	x		
• mixing heads	≤ 0.3 Ohm	x		
3. Electrostatic field strength				
– enclosure of foaming machines	0 kV/m	x		
– window of the dry part	0 kV/m	x		
– Insulation of tank, pipes etc.	5 kV/m	x		
4. Electrical circuits / control panels				
– insulation resistance	≥ 30 mega Ohm	x		
– over current protection	o.K.	x		
5. Exhausting system				
– Fan door area wet part	– speed 1: 5,6 m/s	x		
	– speed 2: 5,8 m/s	x		
– Fan door area dry part outside	– speed 1: 6,5 m/s	x		
	– speed 2: 5,7 m/s	x		
– Fan door area dry part inside	– speed 1: 11,5 m/s	x		
	– speed 2: 11,6 m/s	x		

5.4.4 Detected deficiencies and required actions

– Door line

- Foaming machine (wet part)
- Door plant (dry part)

		Responsible BO = Bono/Cannon Bai = Baixue	
		BO	Bai
1.	<u>Remark</u> The most deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time. The solutions were controlled by the TÜV experts in an additional inspection. All deficiencies mentioned in the draft report were solved and this were confirmed by BONO and Baixue.		
2.	<u>Wet part</u>		
2.1	Control panel foaming machine		
	a) The connections of the main cable has to be carried out in a professional way (use of logs)		done 4/11/00
	b) Electrical heating for the tank The result of the measured insulation resistance is less than the required value (result of testing: 0.1 mega Ohm). This measurement must be done again after the heating has worked some hours. If the insulation resistance is improved after that (e.g. 1,0 mega ohm) the wetness is the reason for the low resistance. Otherwise a fault on the heating is the reason.	done 10/1/01	
2.2	Safety function test The monitoring of the nitrogen pressure inside the tank doesn't function.	done 4/11/00	
2.3	Chiller system The solenoid valve at the pipe of the chiller is positioned inside the wetpart enclosure. In case of the 1 st . level alarm this solenoid valve must be deenergised by the automatic shut down function.	done 4/11/00	done 4/11/00

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
2.4	<p>Fuse box and electrical installation behind the foaming machine (area of polyol an isocyanate) The electrical equipment is inside the 5.00 m zone around the wetpart, that means the equipment and the installations have to fulfil the relevant international regulations. At the existing installation the requirements are not fulfilled. (some examples: fuses without box, no use of the cable glands, cables are not attached, connections are made without logs)</p>	done 4/11/00	done 4/11/00
3.	<u>Dry part</u>		
3.1	<p>Jigs: For the realisation of the potential equalisation and grounding, the wire connections have to be carried out in a professional manner, i.e. use of lugs an springs washers.</p>		done 4/11/00
3.2	<p>Electrical installation in the 5.00 m - zone around the dry part The electrical equipment is inside the 5.00 m zone doesn't fulfil the relevant international regulations. (some examples: for connections the wires are twisted only, the connections are made without terminal boxes, instead cables wires are used.)</p>		done 10./1/01
4.	<u>General matters / required measures</u>		
4.1	<p>Safety organisation Following documentation about the organisation of safety related aspects must be available:</p> <p>a) The organisation in case of alarms (1st / 2nd / 3rd): The behaviour of the operators, workers, guards, technicians must be fixed and organised.</p> <p>b) The organisation for regularly safety checks, inspections and training</p> <p>c) An approval/confirmation of the safety training by the technicians of Baixue.</p>		done 10/1/01 done 10/1/01 done 10/1/01
4.2	<p>Pentane marking on the refrigerators Refrigerators with pentane in the foam must have a marking where the use of pentane as blowing agent is recognisable.</p>	done 4/11/00	
4.3	<p>Sprinkler system The system was not complete equipped and could not be tested</p>		done 10/1/01

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.

The people should get a appointment to this particular work by the management.

Experts

The experts are experienced in this field. They have additional the knowledge of a lot of different plants and also of the accidents who happened. They are independent and have a special approval by the government.

6.3.2 Safety relevant checks, organisation and training

The relevant works, which are listed in the following table must be done:

No	Plant	Kind of check	Qualification	Check time
1	Foaming plant complete	Visual check	CP	daily
2	Foaming plant complete	technical maintenance	CP	monthly
3	Safety equipment e.g. Pentane 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	Foaming plant 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	Foaming plant 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

7. Conclusion

The inspection of the installation of the related plants of UNIDO Project took place from. 26th July 2000 – 29th July 2000.

The Baixue Company will be allowed to hold a safety certificate for plants 1 and 8 after all deficiencies are solved by Bono and Baixue and this is confirmed to TÜV with Memorandum of 11th January 2001.

The above mentioned plants fulfil all relevant safety standards and the requirements of the TÜV Süddeutschland experts.

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

The Certificate is only valid when Baixue fulfilled all requirements mentioned in this report.

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

This Certificate will be valid till July 2003.

The experts

signed
K-J Richardt

signed
E. Mack

Enclosure:
Certificate

**Report
of the safety inspection
of the CFC-conversion of Baixue Factory 2 and 3**

**Bau und
Betrieb**

Plant Location: **Baixue**
Changshu Refrigerating Equipment Works
149 Huayuanbang Road
Changshu, Jiangsu, P.R.China

Plants:

- **Factory 2**
 - C-5 Storage area
 - Pre-mix area
 - Cabinet Line
- **Factory 3**
 - C-5 Storage area
 - Pre-mix area
 - Cabinet line

Project: Conversion of the Freezer and Refrigerator
Plants with Pentane as blowing agent

UNIDO-Project: MP/CPR/97/183
UNIDO Order No 98 / 017 with Bono

TÜV-ORDER No.: 200 377 990

TÜV-Experts: Karl-Josef Richardt - TÜV-BB-ULM, Dep. NDD
Eberhard Mack - TÜV-BB-ULM, Dep. NEG

Data:

- 3rd - 4th November 2000
 - Inspection of the plants at Baixue
- November 2000 to January 2001
 - Preparation of Report

Participants:

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File: Bon/Bai2+3/PRC/03/01

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1. OBJECTIVE AND SCOPE OF THE PLANT EVALUATION

The Baixue Company Factory 2 and 3 in Changshou, P.R. China are 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 hazard class AI. 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

The final inspection of the Baixue Factory 2 and 3 took place from 3rd to 4th November 2000.

The results of this inspection are mentioned in this report.

The items were discussed with representatives of Bono/Cannon and Baixue during the mission of TÜV in Changshu P.R.China.

The deficiencies and measures, came up during the inspection were solved by technicians of Cannon and Baixue. The solved deficiencies were inspected on the last day again.

The Remarks mentioned in this report must be fulfilled by Bono/Cannon and Baixue.

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 (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 Factory 2 and 3

The relevant documentation of Cannon/Bono was delivered in September 2000 and November 2000 and was available on site during the inspection.
The documentation included:

- a) Documentation for all Baixue plants (1,2,3,8) (2 files drawing)
Job. No.: 2298 22011
included relevant drawings for installation

Factory 2 and 3:

Drawings related to Factory 2 and 3 Job No.: 229 822 011

- a. Inspection Book IB 00/110-2 Rev.0 (20.04.00 Vol1) and
Inspection Book IB 00/110-3 Rev.0 (20.04.00 Vol1)
- b. Mechanical Manual MM00/118-2 Rev.0 (17.04.00) Vol1 and
Mechanical Manual MM00/118-3 Rev.0 (17.04.00) Vol1
- c. PM 40 Twin 27 12 20 (factory 2)and
PM 40 Twin 271018 (factory 3)
- Diagram + Spare parts
- Use and Maintenance
- d. Penta Easy froth 20 + 4 No. 550 683 (should be 550 684 on type plate) and
Penta Easy froth 20 + 4 No. 550 685
- e. Operating manual for plant 2, 3 and 8 MI 00 / 101 Date 21.09.00
- f. File with electrical wiring diagrams

2.4 Documentation of Baixue

Documentation which included following tasks were available:

- C5-safety regulations for the security guard
- Management Regulations of C5 storage stations
- Training regulations of safety production
- Emergency procedures during C5 foaming and R600a charging
- Safety management Regulations for cfc-free production
- Instruction of unloading process C5 storage area

During the start up time several parts of these documentation must be completed and updated.

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	Al	< - 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.

d) 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.

e) 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 Plant 2

4.1 Parts of TÜV inspection

Following plants and equipment are part of this inspection:

- c-Pentane Tank area
- Pipe to the polyol / c5-mixing unit
- Polyol/c5-Mixing unit
- Cabinet foaming area

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 10.000 liters.

This tank will be filled by truck. The truck is usually pressurised.

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

The C5 pipe to the premix room is aboveground and will be fed by 2 red jacket pumps.

The area in which C5 will be released in case of 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 and a separate pit outside the danger area. From this pit the rain water will taken out before loading of tank starts by a special pump.

The electrical control panels are installed outside the explosion zone of the c5 storage area in a separate small building.

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
 - The interior of the c5 catch basin
 - A circle with a radius of 1 m about the end of the c5 tank exhausting systems
- 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.
- 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		
- emergency push button (control panel)		X		
2. Alarm signals to guard room		X		
3. C5 tank				
3.1 leakage monitoring:				
a. Double wall				
- minimum contact		X		
- maximum contact		X		
- flow of the monitoring liquid		X		
3.2 N ₂ -pressurization				
- N ₂ -low (200 mbar)		X		
- N ₂ -min (10 mbar)		X		
3.3 c5-level monitoring				
- maximum level(90 %)		X		
- super max. level (95 %)		X		
- signal (30%)		X		
- low level (10 %)		X		
				- Requirement of the red jacket pump approval (both pumps stop)
4. c5-basin		X		
5. Pressure testing of pentane pipeline		X		- test was done under supervision of Cannon - test record is submitted
B) Measurements				

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
1. Electrical resistance of floor (conductivity) <ul style="list-style-type: none"> - position of tank-truck during unloading - explosion dangerous area around the tank-equipment 	5-15 kOhm 50-70 kOhm	x x		
2. Ground/earth resistance <ul style="list-style-type: none"> - earth resistance <ul style="list-style-type: none"> • earth system • lightning protection - Potential equalisation <ul style="list-style-type: none"> • tank equipment • truck grounding 	0,7 ohm 0,7 ohm ≤ 0.3 ohm 0.1 ohm	x x x x		
3. Conductivity <ul style="list-style-type: none"> - racking hoses 	< 10 ⁶ ohm	x		
4. Electrical circuits/control panel <ul style="list-style-type: none"> - insulation resistance - over current protection - over voltage protection 	≥ 30 mega ohm adjustments and system o.k.	x x x		- a correction was necessary

4.2.4 Result and remarks

- Pentane storage area -

1. Remark

The deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time.

The solutions were controlled by the TÜV experts during an additional inspection at the last day of inspection.

In this chapter only some remarks are mentioned which must be taken into account during the production with pentane.

2. Area of c5-tank / c5-tank and equipment

2.1 The gas return line can not be used because the truck must be emptied by compressed air. In case an other system will be used the unloading instruction must be changed.

2.2 The table to see how much is a meter of the filling indicator in litre of pentane must be available at the unloading area.

Responsible	
BO = Bono/Cannon Bai = Baixue	
BO	Bai
	x
	x

4.3 Pre-mix area factory 2 and safety equipment

- Easy Froth
- c5-safety control panel
- Power back-up generator

4.3.1 Brief description of the plant

The Cannon Pre-mix unit Easy Froth is used. The Easy Froth is inside a cabin near cabinet foaming line.

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

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

The electrical control panel for the Easy Froth is installed outside the cabin.

The easy Froth-cabin is in the safety point of view equipped and controlled by artificial ventilation, gas sensor and leakage monitoring.

The day tank of the foaming machine is supplied with c5/polyol from the Easy Froth unit.

For the entire pentane monitoring of the wet part- and the dry part plant a c5-safety control panel is placed near by the wet part. The pentane alarm-signalling also from this safety panel to the always manned guard room.

A power back-up generator with a diesel engine is installed in a building near by the c5-storage area. This generator supplied the pentane safety equipment in factory 2 and 3.

Further details are described in the Bono / Cannon documentation.

4.3.2 Zone Definitions and Dimensions

- a) Alarm-zone
 - Inside the of Easy Froth cabin.
- 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) Fire danger zone
 - The surrounding area of 5 m around the Easy Froth-cabin

4.3.3 Measurements/Function tests

- Easy Froth-Intermediate tank area
- c5-safety control panel
- Back-up generator

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
- Easy Froth				
1. Gas warning system - 15% LEL - 30% LEL - system error		x x x		- one electronic card was damaged; the change of this card is confirmed by Baixue
2. Emergency push-button - pentane emergency push button (1 st -level) - Emergency push button (control panel)		x x		
3. Alarm signals to guard place		x		
4. Exhausting system - flow sensor • Easy Froth - test smoke - functions 15 % LEL	o.k.	x x x		
5. Leakage sensor - fire extinguisher - water hydrants		x x		
6. Exit lamps /emergency lamps		x		- emergency lamp was missing in the guard room
7. Fire fighting system - Thermo sticks - Sprinkler system		x x		- the water pressure was too low; the change of this fault is confirmed by Baixue.
8. Door monitoring - doors of Easy Froth		x		
11. Increase of alarm levels - increase from 3rd to 2nd level alarm - increase from 2nd to 1st level alarm		x x		
12. P-max. control - Easy froth		x		

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
Easy froth				
1. Electric resistance of floor (conductivity) - floor 1m around Easy Froth	6-20 kohm	x		
2. Ground/earth resistance - earth resistance • earth system • lightning protection (ventilation system) - Potential equalisation • Easy Froth • plant equipment (pipes, ventilation channels)	0.2 ohm 0.7 ohm ≤ 0.3 ohm ≤ 0.3 ohm	x x x x		
3. Electrostatic field strength - enclosure of Easy Froth - insulation of pipes etc	0 kV/m 0 kV/m	x x		- grounded bars are mounted on the windows
4. Electrical circuits/control panels - Insulation resistance - over current protection	30 mega ohm adjustment o.k.	x x		
5. Exhausting system - Fan for complete plant	- speed 1: 9,5 m/s - speed 2: 12,5 m/s	x x		
C) c5-safety control panel				
1. Function tests - monitoring of circuit breakers and fuses - push button for testing of signalling - supply by UPS		x x x		
2. Presence and adjustment-control - timer relays over current - protection device - over voltage protection device		x x x		- for the connection a change was necessary
3. Measurements - circuits-insulation	≥ 30 M ohm	x		

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
D) Back-up Generator				
1. Function tests - running without load - running with load - automatic start in case of power failure		x x x		- 1 st attempt didn't function i.e. a change was necessary

4.3.4 Result and remarks

- Easy Froth
- c5-safety control panel
- Back-up generator

1. Remarks

1.1 General

The deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time.

The solutions were controlled by the TÜV experts during an additional inspection at the last day of inspection.

In this chapter only some remarks are mentioned which must be taken into account during the production with pentane.

1.2 Confirmation by Baixue:

A fax-message, dated on 17th, November 2000 signed by Mr. Feng Jian with the confirmation of solutions of deficiencies is submitted.

2. Easy Froth

To unload material for testing no plastic pipe must be used.

3. Organisation matters

3.1 The safety matrix must be used for the checks of the safety devices.

3.2 Preparation of warning signs

For maintenance and repair of the plants is can sometimes be necessary to change the set points on devices for a short time.

To avoid the case that the re-adjustment could be forgotten, special moveable warning signs must be prepared and used.

Responsible	
BO = Bono/Cannon	
Bai = Baixue	
BO	Bai

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4. Sprinkler system

The general system was installed. There were not all connections to the water source in 30 m high. It must be organised that always all valves in the water pipe are open and the tower with the water is always filled.

The responsibility must be clear.

Responsible	
BO = Bono/Cannon Bai = Baixue	
BO	Bai
	x

4.4 Cabinet Line Factory 2

4.4.1 Brief description of the plant

The cabinet line consists of a PU foaming machine Type PM 40 which is in an enclosure. The dry part is designed as a carousels with movable jigs. The mixing head supplied by the foaming machine is manual handled for the foam injection by the operator.

The jigs are heated in an oven which is supplied by hot air.

The pipes to the mixing head are on a pipe bridge. As connection cutting rings are used.

The foam pouring area is special ventilated and a water sprinkler and fire detection system is installed. To recognise pentane and switch of certain devices a gas alarm system is installed.

Before the foam injection starts nitrogen flushing will be carried out via the mixing head.

The production of nitrogen is realized by a N₂-generator.

During foam rising the transportation of the jigs is blocked for 90 sec. i.e. the evaporation of pentane is finished before the jig comes into the oven.

More details are in the Cannon/Bono documentation.

4.4.2 Zone definitions and dimensions

a) Alarm zone

- The interior of the cabin with the wet part
- The interior of the enclosure with the dry part till the entrance of the heating tunnel.

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 polyol / c5 tank
- The interior of the refrigerator cabinets after flushing by nitrogen

d) Fire hazard zone

A surrounding of 5 m around the wet-part and the dry-part.

4.4.3 Measurements / Function tests

– Cabinet line Factory 2

- Foaming machine, Typ PM 40 Twin (wet part)
- Cabinet plant (dry part)

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
1. Gas warning system – 15 % LEL – 30 % LEL – system error		x x x		
2. Emergency push-button – pentane emergency push button (1 st level) – emergency push button (control panel)		x x		
3. Alarm signals to guard place		x		
4. Exhausting systems – flow sensor near fan – test smoke – functions 15 % LEL		x x x		
5. Leakage system – basin wet part – pump wet part – stirrer tank wet part – stream distributor dry part		x x x x		
6. Polyol / C5 tank – Super max – N ₂ -min – Safety thermostat		x x x		
7. Door monitoring wet part / dry part		x		
8. Fire fighting system – Thermo sticks – Sprinkler system		x x		– an improvement of the cable connection was necessary – the water pressure was too low; the change of this fault is confirmed by Baixue
9. Increase of alarm levels				

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
<ul style="list-style-type: none"> - increase from 3rd to 2nd level alarm - increase from 2nd to 1st level alarm 		x		
10. Block of jig moving 90 s after pouring		x		- a protection on the timer relay was necessary
11. N ₂ -inertisation of cabinet <ul style="list-style-type: none"> - N₂-pressure monitoring - N₂-flow monitoring - Set Hi Alarm on generator <4% - N₂-alarm to the c5-safety panel 		x x x x		
B) Measurements				
1. Electrical resistance of floor (conductivity) <ul style="list-style-type: none"> - 1.00 m surrounding of foaming machine - dry part 	270 - 400 kOhm 15 - 30 kOhm	x x		
2. Ground/earth resistance <ul style="list-style-type: none"> - earth resistance <ul style="list-style-type: none"> • earth system • lightning protection (ventilation system) - Potential equalisation <ul style="list-style-type: none"> • foaming machines • dry part plants • jigs • mixing head 	0,7 ohm 0,7 ohm ≤ 0.3 ohm ≤ 0.3 ohm 0.3 ohm 0.3 ohm	x x x x x x		- a lightning arrester system on the building is planned by Baixue
3. Electrostatic field strength <ul style="list-style-type: none"> - enclosure of foaming machines - window of the dry part - Insulation of tank, pipes etc. 	0 kV/m 10 kV/m max. 10 kV/m	x x x		- grounded bars are mounted on the windows
4. Electrical circuits / control panels <ul style="list-style-type: none"> - insulation resistance - over current protection 	≥ 30 mega ohm (0,8 mega ohm tank. Heater door plant) o.K.	x x		
5. Exhausting system <ul style="list-style-type: none"> - Fan complete plant 	- speed 1: 9,5 m/s - speed 2: 12,5 m/s	x x		
6. Inertisation <ul style="list-style-type: none"> - flushing time - O₂ concentration cabinet line 	- as automatic calculated 6,5 % O ₂	x x		- depends on amount of foam

4.4.4 Result and remarks

– **Cabinet Line Factory 2**

- **Foaming machines, typ PM 40 Twin**
- **Cabinet plants (dry part)**

		Responsible BO = Bono/Cannon Bai = Baixue	
		BO	Bai
1. Remark			
1.1 <u>General</u>	<p>The deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time.</p> <p>The solutions were controlled by the TÜV experts during an additional inspection at the last day of inspection.</p> <p>In this chapter only some remarks are mentioned which must be taken into account during the production with pentane.</p>		
1.2 <u>Confirmation by Baixue</u>	<p>A fax-message, dated on 17th, November 2000 signed by Mr. Feng Jian with the confirmation of solutions of deficiencies is submitted.</p>		
2. Wetparts			
2.1 <u>Pipes</u>	<p>a) The screws of the SEA flanges are partly to short. After each maintenance the correct screws must be used.</p> <p>All exits of pipes must be closed additional to the valve with a blind screw. This must be realised also after each maintenance. During the training the people must be shown the importance of that.</p>	<p>x</p> <p>x</p>	
2.2 <u>Inertisation</u>	<p>The N₂ concentration of the generator is adjusted > 96%. This must not be changed.</p>	x	
3. Water Sprinkler system			
a) The handles (wheels) on the manual valves must be removed or secured against usage by unauthorised persons.			x

5. Results of inspection and evaluation Plant 3

5.1 Parts of TÜV inspection

- Following plants and equipment are part of this inspection:
- c-Pentane Tank area
- Pipe to the polyol / c5 mixing unit
- polyol / c5 mixing unit
- Cabinet foaming area

Not part of this TÜV inspection are:

- Polyol/Isocyanat-Storage areas

5.2 C5 storage area

5.2.1 Brief description of the plant

Pentane is stored in an underground tank with a capacity of 10.000 liters.
This tank will be filled by truck. The truck is usually pressurised.

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

The C5 pipe to the premix room is aboveground
and will be fed by 2 red jacket pumps.

The area in which C5 will be released in the case of leakage during the filling process
is designed as a liquid catch basin.

The sewage system is separated from the C5 catch basin by a special valve and a
separate pit outside the danger area. From this pit the rain water will taken out before
loading of tank starts by a special pump.

The electrical control panels are installed outside the explosion zone of the C5
storage area in a separate small building.

5.2.2. 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
 - The interior of the C5 catch basin
 - A circle with a radius of 1 m about the end of the C5 tank exhausting systems
- 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.
- d) Fire hazard zone
 - Total c5 storage area (minimum 5 m around the area)

5.2.3. 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		
- emergency push button (control panel)		x		
2. Alarm signals to guard room		x		
3. C5 tank				
3.1 leakage monitoring:				
a. Double wall				
- minimum contact		x		
- maximum contact		x		
- flow of the monitoring liquid		x		
3.2 N ₂ -pressurization				
- N ₂ low (200 mbar)		x		
- N ₂ -min (10 mbar)		x		
3.3 c5-level monitoring				
- maximum level(90 %)		x		
- super max. level (95 %)		x		
- signal (30%)		x		
- low level (10 %)		x		- Requirement of the red jacket pump approval (both pumps stop)
4. c5-basin		x		
5. Pressure testing of pentane pipeline		x		- test was done under supervision of Cannon - test record is submitted

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
1. Electrical resistance of floor (conductivity)				
– position of tank-truck during unloading	10-15 kOhm	x		
– explosion dangerous area around the tank-equipment	50-70 kOhm	x		
2. Ground/earth resistance				
– earth resistance				
• earth system	0.5 ohm	x		
• lightning protection	0.5 ohm	x		
– Potential equalisation				
• tank equipment	≤ 0.3 ohm	x		
• truck grounding	0.1 ohm	x		
3. Conductivity				
– racking hoses	< 10 ⁶ ohm	x		
4. Electrical circuits/control panel				
– insulation resistance	≥ 30 mega ohm	x		
– over current protection	adjustments and system o.k.	x		
– over voltage protection		x		

5.2.4 Result and remarks

- Pentane storage area -

1. Remark

The deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time.

The solutions were controlled by the TÜV experts during an additional inspection at the last day of inspection.

In this chapter only some remarks are mentioned which must be taken into account during the production with pentane.

2. Area of c5-tank

2.1 Instructions

The instruction to empty the water pit by pump before unloading the truck must be clear for the relevant people.

2.2 Pipe

The parts of the pipe which are not easy visible must be included in the regularly check.

Responsible	
BO = Bono/Cannon Bai = Baixue	
BO	Bai

5.3 Pre-mix area

5.3.1 Brief description of the plant

The Cannon Pre-mix unit Easy Froth is used. The Easy Froth is inside a cabin near cabinet foaming line.

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

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

The electrical control panel for the Easy Froth is installed outside the cabin.

The easy Froth-cabin is in the safety point of view equipped and controlled by artificial ventilation, gas sensor and leakage monitoring.

The day tank of the foaming machine is supplied with c5/polyol from the Easy Froth unit.

For the entire pentane monitoring of the wet part- and the dry part plant a c5-safety control panel is placed near by the wet part. The pentane alarm-signalling also from this safety panel to the always manned guard room.

A power back-up generator with a diesel engine is installed in a building near by the c5-storage area. This generator supplied the pentane safety equipment of factory 2.

Further details are described in the Bono / Cannon documentation.

5.3.2 Zone Definitions and Dimensions

a) Alarm-zone

- Inside the of Easy Froth-cabin.

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) Fire danger zone

- The surrounding area of 5 m around the Easy Froth-cabin.

5.3.3 Measurements/Function tests

- Easy Froth
- c5-safety control panel
- Back-up generator

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
A) Function tests -Easy Froth				
1. Gas warning system - 15% LEL - 30% LEL - system error		x x x		
2. Emergency push-button - pentane emergency push button (1 st -level) - Emergency push button (control panel)		x x		
3. Alarm signals to guard place		x		
4. Exhausting system - flow sensor • Easy Froth - test smoke - functions 15 % LEL	o.k.	x x x		
5. Leakage sensor - Easy Froth Sensor 1 - Easy Froth Sensor 2		x x		
6. Exit lamps (battery)		x		
7. Fire fighting system - fire extinguisher - water hydrants		x x		
8. Door monitoring - doors of Easy Froth		x		
9. Increase of alarm levels - increase from 3rd to 2nd level alarm - increase from 2nd to 1st level alarm		x x		
10 P-max. control - Easy froth		x		
B) Measurements Easy froth				
1. Electric resistance of floor (conductivity - floor in the room	30-60 kohm	x		
2. Ground/earth resistance - earth resistance				

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
<ul style="list-style-type: none"> • earth system • lightning protection (ventilation system) - Potential equalisation <ul style="list-style-type: none"> • Easy Froth • plant equipment (pipes, ventilation channels) 	0.7 ohm 0.7 ohm ≤ 0.3 ohm ≤ 0.3 ohm	x x x x		- some improvements were necessary
3. Electrostatic field strength - enclosure of Easy Froth - insulation of pipes etc	0 kV/m 0 kV/m	x x		- grounded bars are mounted on the windows
4. Electrical circuits/control panels - Insulation resistance - over current protection	30 mega ohm adjustment o.k.	x x		
5. Exhausting system - Fan for complete plant Part Easy Froth	- speed 1: 11 m/s - speed 2: 13,7 m/s - speed 1: 8 m/s - speed 2: 9,3 m/s	x x x x		
C) c5-safety control panel				
1. Function tests - monitoring of circuit breakers and fuses - push button for testing of signalling - supply by UPS		x x x		- the installation of a voltage-stabiliser is foreseen yet
2. Presence and adjustment-control - timer relays over current - protection device - over voltage protection device		x x x		
3. Measurements - circuits-insulation	≥ 30 M ohm	x		
D) Back-up Generator				
1. Function tests - running without load - running with load - automatic start in case of power failure		x x x		

5.3.4 Result and remarks

- Easy Froth
- c5-safety control panel
- Back-up generator

1. Remark

The deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time.

The solutions were controlled by the TÜV experts during an additional inspection at the last day of inspection.

In this chapter only some remarks are mentioned which must be taken into account during the production with pentane.

2. Easy Froth

2.1 Afros should check whether it is possible in general to increase the diameter of the small c-5 pipe before the Easy Froth due to the possible mechanical stress.

2.2 The temporary used flexible polyol pipe to the Easy Froth will be changed against a rigid pipe.

3. Organisation matters

The safety matrix must be used for the regularly safety checks.

Responsible	
BO = Bono/Cannon Bai = Baixue	
BO	Bai

5.4 Cabinet Line Factory 3

5.4.1 Brief description of the plants

The cabinet line consists of a PU foaming machine Type PM 40 which is in an enclosure. The dry part is designed as a carousels with movable jigs. The mixing head supplied by the foaming machine is manual handled for the foam injection by the operator.

The jigs are heated in an oven which is supplied by hot air.

The pipes to the mixing head are on a pipe bridge. As connection cutting rings are used.

The foam pouring area is special ventilated and a water sprinkler and fire detection system is installed. To recognise pentane and switch of certain devices a gas alarm system is installed.

Before the foam injection starts nitrogen flushing will be carried out via the mixing head.

The production of nitrogen is realized by a N₂-generator.

During foam rising the transportation of the jigs is blocked for 90 sec. i.e. the evaporation of pentane is finished before the jig comes into the oven.

More details are in the Cannon/Bono documentation.

5.4.2 Zone definitions and dimensions

a) Alarm zone

- The interior of the cabin with the wet part
- The interior of the enclosure with the dry part till the entrance of the heating tunnel.

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 polyol / C5 tanks
- The interior of the refrigerator cabinets after flushing by nitrogen

d) Fire hazard zone

A surrounding of 5 m around the wet-part and the dry-part.

5.4.3 Measurements / Function tests

– Cabinet line Factory 2

- Foaming machine, Typ PM 40 Twin (wet part)
- Cabinet plant (dry part)

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 near fan		x		
– test smoke		x		
– functions 15 % LEL		x		
5. Leakage system				
– basin wet part		x		
– pump wet part		x		
– stirrer tank wet part		x		
– stream distributor dry part		x		
6. Polyol / C5 tank				
– Super max		x		
– N ₂ -min		x		
– Safety thermostat		x		
7. Door monitoring wet part / dry part		x		
8. Fire fighting system				
– Thermo sticks		x		
– Sprinkler system		x		
9. Increase of alarm levels				
– increase from 3 rd to 2 nd level alarm		x		
– increase from 2 nd to 1 st level alarm		x		
10. Block of jig moving 90 s after pouring		x		

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
11. N ₂ -inertisation of cabinet <ul style="list-style-type: none"> - N₂-pressure monitoring - N₂-flow monitoring - Set Hi Alarm on generator <4% - Ng alarm to the c5-safety panel 		x		
B) Measurements				
1. Electrical resistance of floor (conductivity) <ul style="list-style-type: none"> - 1.00 m surrounding of foaming machine - dry part 	30-60 kOhm 30-60 kOhm	x x		
2. Ground/earth resistance <ul style="list-style-type: none"> - earth resistance <ul style="list-style-type: none"> • earth system • lightning protection (ventilation system) - Potential equalisation <ul style="list-style-type: none"> • foaming machines • dry part plants • jigs • mixing head 	0,7 ohm 0,7 ohm ≤ 0.3 ohm ≤ 0.3 ohm 0.3 ohm 0.3 ohm	x x x x x x		- a lightning arrester system on the building is planned by Baixue
3. Electrostatic field strength <ul style="list-style-type: none"> - enclosure of foaming machines - window of the dry part - Insulation of tank, pipes etc. 	0 kV/m 0 kV/m Max. 5.0 kV/m	x x x		- grounded bars are mounted on the windows
4. Electrical circuits / control panels <ul style="list-style-type: none"> - insulation resistance - over current protection 	≥ 30 mega ohm o.K.	x x		
5. Exhausting system <ul style="list-style-type: none"> - Fan complete plant - Part PM 40 Twin enclosure - Part left side dry part enclosure - Part right side dry part enclosure - Channel over jig 	- speed 1: 9,5 m/s - speed 2: 12,5 m/s - speed 1 10 m/s - speed 2 12,5 m/s - speed 1 3,2 m/s - speed 2 4,0 m/s - speed 1 2.6 m/s - speed 2 2.8 m/s - speed 1 9 m/s - speed 2 10 m/s	x x x x x x x x		
6. Inertisation <ul style="list-style-type: none"> - flushing time - O₂ concentration cabinet line 	- as automatic calculated 2,6 % O ₂	x x		- depends on amount of foam

5.4.4 Result and remarks

– Cabinet Line Factory 3

- Foaming machines, typ PM 40 Twin
- Cabinet plant (dry part)

		Responsible BO = Bono/Cannon Bai = Baixue	
		BO	Bai
1.	<p><u>Remark</u></p> <p>The deficiencies detected at the inspection has been solved by Bono/Cannon and Baixue company during the inspection time.</p> <p>The solutions were controlled by the TÜV experts during an additional inspection at the last day of inspection.</p> <p>In this chapter only some remarks are mentioned which must be taken into account during the production with pentane.</p>		
2.	<p><u>Ventilation system</u></p> <p>The ventilation can be improved when the suck of the EasyFroth and especially of PM 40 Twin will be reduced. According to safety requirements of Cannon the PM 40 twin need only 1200 m³/h and we have measured 2800 m³/h. The difference can be used on the left and right side of the dry part enclosure.</p>		
3	<p><u>Wetpart</u></p>		
3.1	<p>Pipes</p> <ul style="list-style-type: none"> – The screws of the SEA flanges are partly to short. After each maintenance the correct screws must be used. – All exits of pipes must be closed additional to the valve with a blind screw. This must be realised also after each maintenance. During the training the people must be shown the importance of that. 		
3.2	<p>The set points on the devices (pressure gauges, thermostat etc.)which were marked with paper stripes will be marked with metal plates and the checkpoints will be checked regularly.</p>		

		Responsible	
		BO = Bono/Cannon Bai = Baixue	
		BO	Bai
4.	<u>N₂-Generator and tank</u> a) The N ₂ concentration of the generator is adjusted > 96%. This must not be changed.		
5.	<u>Water Sprinkler system</u> The general system was installed. There were not all connections to the water source in 30 m high. It must be organised that always all valves in the water pipe are open and the tower with the water is always filled. The responsibility must be clear. This must be checked regularly.		
6.	<u>Completion of the plant</u>		
6.1	Together with the final completion of the plant following works must be finished:		
	a) Installation of the exit- and emergency lamps		X
	b) Revision of the electrical diagrams	X	
	c) Installation of the water-sprinkler-glass	X	
	d) Finalization of the cable connections in the conveyor-panel		X
	e) Installation of the voltage stabiliser in the c5-safety panel		X
	f) Suspension for the hoses to the mixing head	X	
7.	<u>Preparation of warning signs</u> For maintenance and repairs on the plants is can sometimes be necessary to charge the set points on devices for a short time. To avoid the case that the readjustment could be forgotten, special moveable warning signs must be prepared and used.		

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.

The people should get a appointment to this particular work by the management.

Experts

The experts are experienced in this field. They have additional the knowledge of a lot of different plants and also of the accidents who happened. They are independent and have a special approval by the government.

6.3.2 Safety relevant checks, organisation and training

The relevant works, which are listed in the following table must be done:

No	Plant	Kind of check	Qualification	Check time
1	Foaming plant complete	Visual check	CP	daily
2	Foaming plant complete	technical maintenance	CP	monthly
3	Safety equipment e.g. Pentane 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	Foaming plant 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	Foaming plant 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

7. Conclusion

The inspection of the installation of the related plants of UNIDO Project took place from. 3rd November 2000 - 4th November 2000.

The Baixue Company will be allowed to hold a safety certificate for plants 2 and 3.

The above mentioned plants fulfil all relevant safety standards and the requirements of the TÜV Süddeutschland experts. During the production with pentane the mentioned remarks must be taken into account.

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

The Certificate is only valid when Baixue fulfilled all requirements mentioned in the documentation and 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

signed



K.-J. Richardt

signed

E. Mack

Attachment:

Certificate

  SISTEMI	PLANT	PHASING OUT OF ODS AT REFRIGERATOR PLANT OF CHANGSHU REFRIGERATOR EQUIPMENT WORKS (BAIXUE) - CHINA
	CUSTOMER CONTRACT N. JOB N.	UNIDO FOR BAIXUE UNIDO 98/017 PROJECT MP/CPR/97/183 2298220110

C

CERTIFICATE

No.: TÜV- BB-UL 200 368 097

This is to certify that

Subject: Pentane-PU Foaming System
Freezer Factory
Plant 1 and Plant 8

Producer: Cannon Bono Sistemi, Italy

Operated: Baixue
Changshu Refrigerating Equipment
149 Huayuanbang Road
Changshu, Jiangsu, P.R. China

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 26th to 29th July 2000.

This Certification is based on Report
on Technical Plant Inspection and
Evaluation of Baixue Project
TÜV BB-ULM-Ri/Ma
File No.: BON/BAI 1+8-PRC/02/01

This Certification is valid until
July 2003

Ulm, 13 February 2001
TÜV Süddeutschland experts

K-J Richardt E. Mack



CERTIFICATE

No.: TÜV- BB-UL 200 377 990

This is to certify that

Subject: Pentane-PU Foaming System
Freezer Factory
Plant 2 and Plant 3

Producer: Cannon Bono Sistemi, Italy

Operated: Baixue
Changshu Refrigerating Equipment
149 Huayuanbang Road
Changshu, Jiangsu, P.R. China

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 3rd to 4th November 2000.

This Certification is based on Report
on Technical Plant Inspection and
Evaluation of Baixue Project
TÜV BB-ULM-Ri/Ma
File No.: BON/BAI 2+3-PRC/03/01

This Certification is valid until
November 2003

Ulm, 19 January 2001
TÜV Süddeutschland experts

K-J Richardt E. Mask

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