



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

199/088

22795



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

Impianti OMS S.P.A.
Mr. Candiani
Via Sabbionetta 4

I-20050 Verano Brianza (MI)

Bau und Betrieb

Region Baden-Württemberg
Abteilung
Dampf- u. Drucktechnik

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

Your reference/letter of	Our reference/name	Phone/Fax	Date
	BB-DD1-ULM/Ri-se Karl-Josef Richardt	2 30 // 3 60	25.06.2002

Dear Mr. Candiani,

Enclosed we are sending you: Report Yakh Saran and Certificate

- | | |
|--|--|
| <input type="checkbox"/> returned with thanks | <input checked="" type="checkbox"/> for your files |
| <input type="checkbox"/> as per your letter
Date: _____ | <input type="checkbox"/> as agreed by phone
Date: _____ |
| <input type="checkbox"/> as per our letter
Date: _____ | with: _____ |

with a request:

- | | |
|--|---|
| <input checked="" type="checkbox"/> for further processing | <input type="checkbox"/> for a return call |
| <input type="checkbox"/> for your comments | <input type="checkbox"/> for an appointment |
| <input type="checkbox"/> to be taken note of | <input type="checkbox"/> for return to us |

Short message: _____

Best regards

K.-J. Richardt
K.-J. Richardt

TÜV Süddeutschland
Bau und Betrieb GmbH
Aufsichtsratsvorsitzender:
Karsten Puell
Geschäftsführer:
Roland Ayx (Sprecher)
Friedrich Hecker
Sitz: München
Amtsgericht München
HRB 96 869



DAP-PL-2722.03
DAP-IS-3516.01
DAP-PL-2885.99
DAP-PA-2884.99
Test laboratories accredited
by the DAP Deutsches
Akkreditierungssystem
Prüfwesen GmbH (German
accreditation body for testing
organizations)

Kurzbrief zum Gutachten



Report

Safety Inspection
Project: Yakh Saran,



Supplier Impianti OMS Spa
Via Sabbionetta 4
20050 Verano Brianza (Mi) Italy

Location of plant Yakh Saran
Abe-Ali Road, Tehran
Islamic Republic Iran

TÜV-Order-No. 990 329 742 since 2002: 67 600

**Responsible/
Experts** Dipl.-Ing. K.-J. Richardt TÜV BB-NDD-ULM
Dipl.-Ing (FH) A. Lips TÜV BB-NEG-ULM
TÜV Süddeutschland Branch Ulm

Order No-OMS No 119 / 98

Project Conversion of the Refrigerator Plants
with Pentane as blowing agent

UNIDO-Project MP / IRA / 97 / 199

Dates: 19th-21-July 1999
- Pre-inspection of Plant in OMS
August 1999
- Preparation of the Commission List
14-16 May 2002
- Inspection in Yakh Saran / Iran
June 2002
- Report and Certificate

**Participants on
location:** - Mr. Candiani Impianti OMS
(not on site)
- Mr. Gottardi, Lino Impianti OMS
- Mr. Brigo, Cristian Impianti OMS
- Mr. Ebadi Sitco
- Mr. Moghimi Yakh Saran
- Mr. Rezaei Yakh Saran

**Report is
sent to:** OMS - Mr. Candiani
UNIDO - Dr. Malayeri

Bau und Betrieb

Niederlassung Ulm

Benzstraße 17
D-89079 Ulm
Telefon (07 31) 49 15-2 30
Telefax (07 31) 49 15-3 60
www.tuevs.de
E-mail Karl-Josef.Richardt
@tuev-sued.de
Ulm, 24 June 2002

TÜV-BB-ULM/Ri-LI

Oms-Yak-IRA-02-02-Rep2

This document consist of :
29 pages

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

File: OMS/Yak-IRA/02/02



0. Table of contents

1.	OBJECTIVE AND SCOPE OF THE PLANT EVALUATION	3
2	DOCUMENTS AND INFORMATIONS USED AS A BASIS FOR THIS PLANT EVALUATION	4
2.1	Inspection	4
2.2	Technical regulations	4
2.3	Documentation of the PU plants and the peripherals (noch alt!!!)	6
2.4	Documentation of Yakh Saran	7
3.	General definitions of c-pentane-foaming-plants	8
3.1	C5 safety data	8
3.2	Definition of Zones	8
4.	Results of inspection and evaluation.....	10
4.1	Parts of TÜV inspection.....	10
4.2	C 5 storage and supply station.....	10
4.2.1	Brief description of the plant.....	10
4.2.2.	Explosion zones / fire hazard zone.....	11
4.2.3.	Measurements / safety functional tests.....	12
4.2.4	Detected deficiencies and required actions.....	15
4.3	Wetpart – Pentafoam 100/50.....	16
4.3.1	Brief description of the plants	16
4.3.2	Zone definitions and dimensions.....	16
4.3.3	Measurements / Function tests	17
4.3.4	Detected deficiencies and required actions.....	19
4.4	Drypart (Door line).....	20
4.4.1	Brief description of the plants	20
4.4.2	Zone definitions and dimensions.....	21
4.4.3	Measurements / Function tests	22
4.4.4	Detected deficiencies and required actions.....	24
4.5	General safety devices	25
4.5.1	Brief description.....	25
4.5.2	Measurements/Function tests	26
4.5.3	Detected deficiencies and required actions.....	27
5.	Safety relevant working conditions of the pentane foaming plants	28
5.1	Organisational requests	28
5.2	Change of units of the plant	28
5.3	Regularly inspections	28
5.3.1	General requirements.....	28
5.3.2	Safety relevant checks, organisation and education	29
5.4	Incidents / accidents.....	30
5.5	Regularly information's	30
5.6	Issue and Validity of the Certificate	30
6.	Conclusion	31



1. OBJECTIVE AND SCOPE OF THE PLANT EVALUATION

The Yakh Saran Factory in Tehran, Iran is operating polyurethane plants for the manufacture of refrigerators.

As substitute for the used CFC blowing agent R 11, c-pentane (C 5) is used now for the PU foam production. C 5 is a flammable fluid constituting a class A1 hazard. The use of C-5 necessitates fire and explosion protection measures for the C 5 storage and the PU production facilities.

In conjunction with the progressive change-over to combustible blowing agent (C 5) the experts of the Ulm branch of TÜV Süddeutschland have developed an expert strategy. TÜV Süddeutschland has 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

A pre-inspection of the plant had been carried out in July 1999. A commission list had been prepared.

The final inspection in Yakh Saran Factory in Tehran took place 14th May to 16th May 2002.

The results of this inspection are mentioned in this report.

The items were discussed with representatives of OMS and Yakh Saran Refrigerator Factory during the mission of TÜV in Tehran, Iran.

The installation has been on a good technical standard and the main deficiencies detected during the mission were solved during the inspection.

2.2 Technical regulations

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

These include the following essential regulations:

- International standards (ISO, IEC)
- Ordinance Regulating Facilities for Storing, Racking and Transporting combustible Liquids - Germany: VbF
- Decree for electrical plants in explosion dangerous areas, Germany: ElexV
- Decree for pressure vessels, Germany DruckbehV
- Law for immissions protection: Germany BImSchG
- Law for water protection: Germany WHG (protection against water-pollution)
- Electrotechnical regulations: International: IEC / European: EN / National: DIN VDE
e.g. IEC 60073, IEC 439-1/A2, IEC 204-1, IEC 1310-2, EN 50054, EN 50013, EN 50020, EN 50081, EN 60529, pr. EN 1050, DIN VDE 0165, EN 349, EN 418, EN 294



- Fundamental safety aspects to be considered for measurement and control equipment: Germany DINV 19250
- Safety requirements for automated manufacturing systems: Germany VDI 2854
- Personal protection regulations / accidents prevention - European: EN..EC / Germany: UVV/ZH
e.g. VBG 1, VBG 5, VBG 61, ZH 1/200, ZH 1/255, ZH 1/8, ZH 1/10
- Technical regulations for combustible liquids and for gases: Germany TRbF / TRG
e.g. TRbF 100, 110 / TRG 280
- Ex-proof / spark-proof for ventilators: Germany VDMA-24169 part 1
- Homologation of technical plant and equipment - European: conformity certificates (e.g. PTB, Cesi, Damko)
- EN 378, Refrigerating systems and heat pumps, Safety and environmental requirements
- pr EN 1612-2 Reaction moulding machines
- EG machine directive (89/392/ESG, revised edition 91/368/EEC)
- CEI/IEG 335-2-24, Safety of household and similar electrical appliances
- IEC 79-10/EN 60079-10/VDE 0165 Part 101: Electrical apparatus for explosive gas atmospheres - classification of hazardous areas.



2.3 Documentation of the PU plants and the peripherals (noch alt!!!)

The documentation were delivered September 1999.

The complete documentation of OMS were available on site and all the missing parts and updated parts which are mentioned in this report must be delivered to the experts.

The documentation contains following important parts:

- a. Drawings related to Factory Yakh Saran
Yakh Saran foaming plant Lay out - 168 111 001
- b. Foaming machine for Polyurethan
 - Technical Documentation
 - Commissioning and Conformity Certificates
 - Plant's Components Instruction
 - Handbook
 - Item list and Drawings
- c. Tank 25.000 litre Series
 - Storage area flow diagram
- d. Fire fighting system
 - Notifier Italia CAE – 200
- e. Suction Group
 - Handbook
- f. Safety function matrix
- g. Electrical diagrams for panel for sensors and suction



2.4 Documentation of Yakh Saran

During the final meeting in Yakh Saran it was agreed that following documentation will be made completely.

Following were supplied from OMS and partly translated:

- Pentane unloading operation
- C5- general safety regulations (what is forbidden and how to do in case of emergency)
- Safety relevant checks, organisation and education
- Record of test the Cyclo-Pentane pipe

Following must be finished by Yakh Saran

- Record about maintenance in c-5-area
- Operator instruction for production with Pentane
- Instructions related the fire fighting system
- Special instructions what to do in case of an accident



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 2	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.

d) Zone of Nitrogen (N₂) inertisation

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



4. Results of inspection and evaluation

4.1 Parts of TÜV inspection

Following plants and equipment are part of this inspection:

- c-Pentane storage and supply area
- Pipe to the Wet part
- Pentafoam HP 100/50
- Foaming area for Doors (Cabinets)
- Ventilation system
- Safety relevant parts like Safety panel, Backup Generator, Inertisation system, Fire fighting system storage area

Not part of this TÜV inspection are:

- Polyol and Isocyanate Storage areas

4.2 C 5 storage and supply station

4.2.1 Brief description of the plant

Pentane is stored in an underground tank with a capacity of 25.000 litre. This tank will be filled by drum pump from drums.

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

The C 5 pipe to the premix system is partly inside the ground and controlled and the part inside of the factory is aboveground.

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.



4.2.2. Explosion zones / fire hazard zone

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

- a) Explosion zone 0
 - The interior of the C 5 storage tanks and drums (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
 - 2 meters around the drum and unloading pipe connection during the unloading time
 - 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.
 - Leakage catch system
- 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	Effect	Conforming to safety strategy		Remarks
		yes	no	
A) <u>Function tests</u>				
1. Pentane emergency push button - pentane emergency push button (1 st level)	Stop filling pump Stop feeding pump Signal on safety panel	x x x		A separate remote panel has not been installed. OMS can supply the contacts
2. Leakage sensor 2.1 Leakage from pneumatic pumps	Stop pump Red light Acoustic signal(2 nd tone) Signal on safety panel	x x x x		
3. Tank N ₂ pressure 3.1 N ₂ -min of tank Set is 0,6 bar	Stop feeding pump Acoustic signal Signal red light Signal on safety panel	x x x x		
4. N ₂ pressure of jacket 4.1 Tank min (0,2 bar) and max (0,5 bar)pressure 4.2 Pipe min: 0,5 bar max : 2 bar	Close tank fail safe valves Stop pumps Acoustic signal Signal red light Signal on safety panel Close tank fail safe valves Stop pumps Acoustic signal Signal red light	x x x x x x x x		



Plant/component	Effect	Conforming to safety strategy		Remarks
		yes	no	
	Signal on safety panel	x		
5. Overfilling alarm				
5.1. Pentane tank	Stop filling pump	x		
	Acoustic signal	x		
	Signal red light	x		
	Signal to safety panel	x		
6. c5-basin		x		
7. Grounding drum		x		
8. Pressure testing of pentane pipeline		x		- test was done under supervision of OMS
9. Safety relief valve of pipe	8 bar	x		
10. Alarm signals to guard room				- OMS has installed the contact
12. Sprinkler system	Start water pump Open solenoid valve	x		- start is manual
13. Fire extinguisher		x		
14. Light			x	- installed but must be connected



Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
1. Electrical resistance of floor (conductivity)				
– Floor of basin	$10^6 \text{ ohm} < 10^8 \text{ Ohm}$	x		
– Floor over tank	$10^6 \text{ ohm} < 10^8 \text{ Ohm}$	x		
2. Ground/earth resistance				
– Potential equalisation				
• Grounding clamp	$\leq 0.3 \text{ ohm}$	x		
• tank equipment	$\leq 0.3 \text{ ohm}$	x		
• tank	$\leq 0.3 \text{ ohm}$	x		
• pipes	$\leq 0.3 \text{ ohm}$	x		
3. Conductivity				
– unloading hose		x		- metallic
4. Lightning protection	9 Ohm	x		
5. Electrical circuits/control panel				
– over current protection	adjustments and system o.k.	x		- in supply panel
– over voltage protection		x		- in safety panel
6. Sprinkler system				
– over current protection		x		-



4.2.4 Detected deficiencies and required actions

- Pentane storage area -

	Responsible	
	OMS	Yakh Saran
1. <u>Remark</u>		
The most deficiencies detected at the inspection has been solved by OMS and Yakh Saran company during the inspection time.		
The solutions were controlled by the TÜV experts at the last day of the inspection on site.		
Following mentioned actions must be done at least during the next 3 month.		
2. Actions needed		
a) An equipment to carry the drums to the unloading place must be used.		x
b) The well near the tank must be covered in a stable way and not by paperboard.		x
c) The existing declaration of the producer of the tank that the tank has been manufactured according to the OMS drawings must be supplied to the experts.	x	
d) The record about the pressure test must be supplied	x	x
e) The ex-zones inside the storage area (drum unloading station) must be marked on the ground/floor)		x
f) The light within the tank area must be connected finally		x
g) The function list must be updated	x	
h) The instructions of the tank unloading procedure must be finished and must be displayed in the tank unloading area	x	x



4.3 Wetpart – Pentafoam 100/50

4.3.1 Brief description of the plants

The OMS Pentafoam Nr. 0955 (8/99) Comm:119/99 is used. The pentane has been supplied by a separate feeding pump.

From there the Dry part (door line) are supplied.

The pipes are on a pipe bridge.

Before the foam injection starts, the moulds could be filled with nitrogen. A suitable inertisation system has been installed. (It had not been used during the inspection because only moulds with open injection were used)

The electrical control panels for the machines are installed outside the enclosure near the enclosure.

The enclosure is equipped with a fire detection and fire fighting system

Further details are described in the OMS documentation.

4.3.2 Zone definitions and dimensions

a) Alarm zone

- The interior of the cabin with the Pentafoam

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) The pipes which have connection with the pentane / pentane –polyol material and which are not complete filled.

c) Zone of Nitrogen inertisation:

- The interior of the polyol / C 5 day tank.

d) Fire hazard zone

- A surrounding of 5 m around the enclosure



4.3.3 Measurements / Function tests

- Pentafoam 100/50
 - Mixingpart
 - Daytank and HP pump

Plant/component	Result	Conforming to safety strategy		Remarks
		yes	no	
A) <u>Function tests</u>				
1. Gas alarm 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				- contact is available
4. Exhausting system				
- flow sensor		x		
- test smoke		x		
- start 2 nd fan		x		
5. Leakage system				
- sensor in enclosure		x		
- feeding pump (blend)		x		
- stirrer tank buffer tank		x		
6. Polyol / C5 tank (day tank)				
- Super max		x		
- N ₂ -min		x		
- Safety thermostat		x		
- safety relief valve		x		-ISPESL
8. Door monitoring wet part		x		
9. Fire fighting / detecting system (OMS)				
Alarm from sensor		x		
Connection to CO ₂ system		x		
Stop both fan		x		



Plant/component	Result	Conforming to safety strategy		Remarks
		yes	no	
Cut off power Visual and acoustic signal Signal to safety panel		x		
Limitation of work of CO ₂ system – Door open – Door closed	CO ₂ can not work CO ₂ can work	x x		

Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
1. Electrical resistance of floor (conductivity) – inside of enclosure	3 M Ohm < 10 ⁸ Ohm ≤ 0.3 ohm	x x		metall
2. Ground/earth resistance – Potential equalisation • Pentafoam • enclosure • Ventilation tubes	≤ 0.3 ohm ≤ 0.3 ohm ≤ 0.3 ohm	x x x		
3. Electrostatic field strength – enclosure of foaming machines – Insulation of tank, pipes etc.	< 50 kV/m 4 kV/m	x x		
4. Electrical circuits / control panels – insulation resistance – over current protection – valve protections – motor protection	< 500 Mohm o.k. o.k. 200 Mohm	x x x x		
5. Exhausting system Channel enclosure Pentafoam	– speed 1: 6,8 m/s – speed 2: 13,0 m/s	x x		



4.3.4 Detected deficiencies and required actions

- Pentafoam 100/50
 - Mixingpart
 - Daytank and HP pump

		Responsible	
		OMS	Yakh Saran
1.	<p><u>Remark</u></p> <p>The most deficiencies detected at the inspection has been solved by OMS and Yakh Saran company during the inspection time.</p> <p>The solutions were controlled by the TÜV experts at the last day of the inspection on site.</p> <p>Actions are mentioned below must be done during the next 3 month.</p>		
2.	<p>Actions needed</p> <p>a) The language at the Nitrogen generator is presently only in Italian. It must be also in Farsi or at least English.</p> <p>b) The channel of the ventilation system must be lead over the roof (at least 1 m) and has to be included in the lightning protection system.</p> <p>c) The electrical cables to the gas sensors must be protected against mechanical stress.</p>	<p>x</p> <p></p> <p>x</p>	<p></p> <p>x</p> <p></p>
3.	<p>Remarks</p> <p>a) The sprinkler system is acceptable in this situation. In case in the sprinkler system will get additional nozzles for other reason a pump to increase the pressure of the water is needed.</p> <p>b) Actually is no remote panel installed. Yakh Saran has planed to install a 24 hour manned alarm station during the conversion of the existing plant.</p>		



4.4 Drypart (Door line)

4.4.1 Brief description of the plants

From the HP pump of the Pentafoam the 2 mixing heads of the door line are supplied. (With the existing system also cabinet jigs can be used)

The drypart consist during the inspection only 2 different moulds. The moulds were inside an area which were limited by 3 walls (the operator side was open). The used moulds were without heating system.

The pipes are on a pipe bridge.

Before the foam injection the moulds could be filled with nitrogen. An suitable inertisation system has been installed.

The system was tested on an empty cabinet. But it will not be used for the moulds were the foam is poured in the open system.

The electrical control panels for the machines are installed outside the dangerous zone

For the line one safety panel is available.

The dry is connected to a sufficient ventilation system.

Within the area a manual sprinkler system is installed.

Further details are described in the OMS documentation.



4.4.2 Zone definitions and dimensions

- a. Alarm zone
 - The interior of the area/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. Explosion Zone 1
 - 100 mm around the moulds during the foam rising time
- d. Zone of Nitrogen inertisation:
 - The interior of the moulds after flushing by nitrogen (in case it will be used for closed moulds)
- e. Fire hazard zone
 - A surrounding of 5 m around the dry-part.



4.4.3 Measurements / Function tests

-
- **Dry parts**
 - Line for Dry parts (Door parts)

Plant/component	Result	Conforming to safety strategy		Remarks
		yes	no	
A) Function tests				
1. Gas warning system <ul style="list-style-type: none"> - 15 % LEL (Level 1) - 30 % LEL (Level 2) - 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				only contact from OMS
4. Exhausting system <ul style="list-style-type: none"> - flow sensor <ul style="list-style-type: none"> • dry part door line - test smoke - function if 15 % LEL 		x		
5. N ₂ -inertisation of dry part <ul style="list-style-type: none"> - N₂-pressure monitoring - N₂-flow monitoring - Quality of inertisation 		x		
6. Block opening of jigs after pouring				- could not be tested because only door moulds were available
7. Back up Generator			x	- Generator was installed but not ready connected



Plant/component	Measuring result	Conforming to safety strategy		Remarks
		yes	no	
B) Measurements				
1. Electrical resistance of floor (conductivity) – inside of open room	$3 \times 10^6 < 10^8 \text{ Ohm}$	x		
2. Ground/earth resistance – resistance of curtain to heater – Potential equalisation • moulds • Ventilation tubes • mixing heads	< 500 Ohm $\leq 0.3 \text{ ohm}$ $\leq 0.3 \text{ ohm}$ $\leq 0.3 \text{ ohm}$	x x x x		
3. Electrostatic field strength – enclosure of foaming part	< 0 kV/m	x		
4. Exhausting system Channel Door line – Dry part	– speed 1: 6,5 m/s speed 1: 11,0 m/s	x x		
6. Inertisation – O ₂ concentration	- 3,0%	x		



4.4.4 Detected deficiencies and required actions

– Dry part (Door line)

		Responsible	
		OMS	Yakh Saran
1.	<p><u>Remark</u></p> <p>The most deficiencies detected at the inspection has been solved by OMS and Yakh Saran company during the inspection time.</p> <p>The solutions were controlled by the TÜV experts at the last day of the inspection on site.</p> <p>Actions are mentioned below must be done during the next 3 month.</p>		
2.	<p>Actions needed</p> <p>a) The labels for the inflammable materials are missing</p> <p>b) The position of the mixing heads must be adjusted related the used moulds. There are different possibilities:</p> <ul style="list-style-type: none"> - change to a close mould by using horizontal mixing head (as available) - Change position of MH at least 45° - use other kind of fixture (as shown in drawing) <p>c) The Position and assignment of the sensors on the control panels must be marked in farsi.</p> <p>d) All flexible cables on the gas alarm system must be supplied with terminals.</p>	<p>x</p> <p>x</p> <p>x</p>	<p></p> <p>x</p> <p>x</p>
3.	<p>Remarks</p> <p>a) At the existing moulds the opening function during the foam rising time can not be blocked. Especially if Yakh Saran will use other moulds or jigs this function must be installed.</p> <p>A special operator instruction is needed.</p>		



4.5 General safety devices

4.5.1 Brief description

To use pentane in a safe way a lot of separate safety system has been installed.

For the dry and wet part each an separate ventilation system which is controlled by a flow switch has been installed.

The safety panel, exit light and the ventilation will be supplied by an backup generator.

The safety control panels consists the gas alarm system and the most safety relevant electrical installation.

Further details are described in the OMS documentation which were available on site.



4.5.2 Measurements/Function tests

– General safety devices

Plant/component	Measuring result	Function Conforming to safety strategy		Remarks
		yes	no	
Tests / Measurements				
A) c5-safety control panel				
1. Function tests – monitoring of circuit breakers and fuses – push button for testing of signalling – supply by UPS		x		- battery and generator (must be connected)
2. Presence and adjustment-control – timer relays – over current protection device – over voltage protection device		x x x		
3. Measurements – circuits-insulation	≥ 30 Mohm	x		
B) Back-up Generator				
1. Function tests – running without load – running with load – automatic start in case of power failure				Could not be done Because the generator Were not connected
C) Sprinkler system				
D) Emergency exit light				
		x		- except final connection of storage area



4.5.3 Detected deficiencies and required actions

– General safety devices

1. Remark

The most deficiencies detected at the inspection has been solved by OMS and Yakh Saran company during the inspection time.

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

Actions are mentioned below must be done during the next 3 month.

2 Actions needed

a) The complete documentation will be supplied

Responsible	
OMS	Yakh Saran



5. Safety relevant working conditions of the pentane foaming plants

5.1 Organisational requests

To run these plant 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.

5.2 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 experts related to the safety.

5.3 Regularly inspections

5.3.1 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.

5.3.2 Safety relevant checks, organisation and education

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

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



5.4 Incidents / accidents

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

5.5 Regularly information's

The carried out inspection is valid maximum till May 2005.

During this time the supervision by the experts will be realised as follow:

- The experts can inspect the yearly record of the internal competent people (CP's) of Yakh Saran
- Information about the training of the CP's must be transmitted.
- The experts can visit the factory at any time especially on request of UNIDO

5.6 Issue and Validity of the Certificate

The Certificate can be issued because all the important safety issues had been installed and were in function.

During the inspection not all small deficiencies could be solved for that reason the Certificate OMS/YAK-IRA/02/02 can be issued only with special conditions.

a) Certificate

The TÜV Süddeutschland BB-Ulm will issue a certificate for the inspected PU-Foaming Plant.

The certificate with the NO: TÜV-BB-Ulm 67 600 is valid until 30th May, 2005.

b) Special condition

The open deficiencies, described in chapter 4.2.4, 4.3.4, 4.4.4 and 4.5.4 must be solved until 30th September 2002.

A confirmation about this must be sent from Yakh Saran and OMS company to Mr. Malayeri of UNIDO and to the signed TÜV experts of TÜV Süddeutschland branch Ulm. If this special condition isn't fulfilled the TÜV-certificate is no longer valid.



Validity of Certificate

The certificate will be only valid in case:

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

6. Conclusion

The inspection of the installation of the related plants of Project Yakh Saran in Tehran Islamic Republic Iran took place from. 14th May 2002 – 16th May 2002.

The installed plant by OMS and Yakh Saran fulfilled the technical safety requests regarding the safety strategy for c5-plants.

The signed TÜV-experts have no safety related doubts concerning the PU plant with pentane as blowing agent

The Yakh Saran Company will be allowed to hold a safety certificate for the related plants. The Certificate is only valid if Yakh Saran will fulfil all requirements mentioned in this report including the requests in Chapter 5.6 (special conditions) of this report.

The next regular safety inspection carried out by experts must be done till end of May 2005.

The issued Certificate will be valid till May 2005.

The experts

signed
K-J Richardt

signed
A. Lips

