



**TOGETHER**  
*for a sustainable future*

## OCCASION

This publication has been made available to the public on the occasion of the 50<sup>th</sup> 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](mailto:publications@unido.org) for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at [www.unido.org](http://www.unido.org)

16835

Distr.  
RESTRICTED  
IO/R.73  
13 June 1988  
ENGLISH

UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

---

Workshop on Maintenance, Plant  
Inspection and Energy Conservation  
in Petroleum Refineries

Vienna, Austria, 7 - 25 March 1988\*

REPORT\*\*

406

\* Organized by United Nations Industrial Development Organization (UNIDO) in  
co-operation with the Government of Austria and OMV Aktiengesellschaft

\*\* This report has been reproduced without formal editing

V.88-25570

## Table of Contents

	<u>Page</u>
A. Introduction	1
B. Organization	1
C. Opening Ceremony	2
D. Summary of Lectures	2
1) Plant Inspection	2
2) Maintenance of Equipment	3
3) Energy Conservation	4
4) Visits and Practical Demonstrations	6
E. Experience Exchange Group = Question and Answer Session	6
F. Closing Ceremony	7
Annex I: List of questions raised	8
Annex II: Assessment of the workshop by the candidates	27
Annex III: List of participants	33

## **A. INTRODUCTION**

The Workshop on Maintenance, Plant Inspection and Energy Conservation in Petroleum Refineries is the sixth one in the field of petroleum refining and the fourth on the subject of maintenance and plant inspection. In co-operation with the Austrian Government and the state-owned petroleum company Osterreichische Mineralölverwaltung (OMV), already five workshops on petroleum refining industries were held in Vienna, Austria:

- a) Workshop on Petroleum Processing, 21 - 30 April 1981;
- b) Workshop on Production Planning and Energy Management in Petroleum Refineries, 3 - 19 May 1982;
- c) Workshop on Maintenance and Plant Inspection in Petroleum Refineries, 5 - 23 September 1983;
- d) Workshop on Maintenance and Plant Inspection in Petroleum Refineries, 5 - 23 November 1984;
- e) Workshop on Maintenance and Plant Inspection in Petroleum Refineries, 17 February - 7 March 1986.

This series of workshops is becoming widely known and has a well established reputation judging by the number of applications received from all over the world and a very severe selection has to be made each time in order to keep the number of participants to a suitable level of 20 - 22 participants. Upto now, about 130 participants from developing countries have attended these workshops, representing refineries from all parts of the world. There is already a request to have similar workshops organized at a regional level like for the Asia/Pacific region, African region and the Middle East.

## **B. ORGANIZATION**

Based on the experience of precedent workshops, it was decided to repeat topics like maintenance and plant inspection, but adding a new dimension with energy conservation in petroleum refineries.

An Aide-Mémoire was dispatched in November 1987 in order to give the background of this series of workshops, its organization and the expected outcome. It was clearly stated that in addition to lectures there will be a maximum of practical demonstrations followed by technical visits. A questionnaire to be filled by potential participants was intending to help the organizers of the workshop to adjust the technical programme to specific needs of the refineries in the field of maintenance, plant inspection and energy conservation. The last week was reserved to an Experience Exchange Group Session and a Question and Answer Group. The outlined programme of lectures is given hereunder:

- Maintenance Management;
- Maintenance of Rotating Equipment;

- Plant Inspection;
- Energy Conservation;
- Utilities;
- Maintenance of Instrumentation;
- Analytical Trouble-Shooting.

### C. OPENING CEREMONY (at UNIDO Headquarters)

The opening speech was delivered by Mrs. Tcheknavorian-Asenbauer, Head of Chemical Industries Branch and Acting Director of Department of Industrial Operations, who on behalf of the Director General of UNIDO welcomed the participants and underlined the importance of similar meetings and especially the importance of maintenance and energy conservation in petroleum refineries in developing countries because of the age of the installations, lack of spare parts and shortage of skilled personnel. It was also the occasion to clarify the field of competence of UNIDO and all the opportunities offered by an international organization.

The hosting organization, OMV, was represented by Dr. Schenz, Director of OMV and Mr. Berger, OMV Refinery Manager. Both mentioned their willingness to welcome the participants for three weeks at Schwechat Refinery.

Mr. Krepela as representative of the Permanent Mission of Austria to UNIDO, which is sponsoring the Workshop, confirmed the readiness of the Austrian Government to finance similar meetings which are very valuable to developing countries.

Mr. Lederleitner, representing the Austrian Federal Economic Chamber and co-sponsor of this Workshop, insisted on the impact of the contacts between the representatives of the petroleum refineries and Austrian vendors and manufacturers.

After a coffee break and settlement of administrative problems the participants were directed to Schwechat Refinery where the programme was implemented.

### D. SUMMARY OF LECTURES

The lectures given were classified in a logical manner: Inspection, Maintenance and Energy Conservation, while they are all inter-linked.

#### 1) Plant Inspection

a) A large chapter was allocated to corrosion and protection of refinery equipment. A survey on modern paints and coatings and the existing corrosion protective systems was given. Special recommendations were given for the protection of the storage tanks and the most exposed parts of the plant.

b) Scheduling of equipment for inspection: Under local government regulations standards and rules of art there is a specific timing between inspections and the scheduling for inspection of each piece of equipment is important in order to allow a smooth operation of the plant with maximum safety and security.

c) Inspection methods: The methods that are generally used in preparation for inspection were described, like visual inspection, hammer testing, on-stream inspections and gagings. The different methods of cleaning (mechanical and chemical) were described and their importance underlined. A special importance was given to the treatment of weldings.

d) Deterioration and failure of equipment and its prevention: The different mechanical causes of failure, failures caused by corrosion and oxydation and methods of protection (especially cathodic protection) were described in detail.

e) Lifetime of equipment: Practical examples for calculation of remaining life and determination of life-expectancy of specific pieces of equipment were studied with tables and micro-graphs of metallographic examination, hardness tests and long-term endurance.

f) Detailed equipment inspection: Examples of typical equipment of the refinery were presented regarding columns, pressure vessels, storage tanks, heat exchangers and cooling towers, furnaces and boilers, pumps, turbines, compressors, instruments, piping, etc.

The functions and duties of the refinery inspector: His qualifications and responsibilities were described.

g) On stream inspection and special testing methods like ultra-sonics, thermovision and sound emission used in the refinery were presented and the results analyzed.

h) The special problems encountered at Schwechat Refinery recently were discussed and the selected solution and its choice justified.

i) Inspection guidelines: Each refinery should have developed an inspection code of practice which will integrate the different rules and regulations of the country. An inspection training manual should be elaborated if not existing and should include condensed details of equipment inspection regarding process heaters, reactors, pressure vessels and columns and heat exchangers.

## 2) Maintenance of equipment

As a matter of introduction to Maintenance, a general overview on the total maintenance function and maintenance strategies was mentioned. The importance of shutdown planning and scheduling was stressed as well as the implementation of maintenance either by subcontractors or by refinery teams.

a) Maintenance of compressors and turbines: The organization and strategy of compressors and turbine maintenance being specific for refinery equipment (case of reciprocating compressors), different methods were described, special technical aspects of compressor and turbine overhaul explained and suggestions made for a record of machines' lifespan. A new method of monitoring the rotating machines using a computer-based system is now used due to the rapid expansion of machinery equipment in the refinery.

b) Maintenance of instrumentation of pneumatic and electronic instruments: The maintenance of all instruments starting with transmitters to controllers, recorders, alarms, control valves, data loggers, alarm printers, etc. is very important whatever the type of instrument may be: pneumatic, digital electronic or micro-processor-based electronic. The general strategy during the "run-period" is different and all actions were listed for an easy reference.

c) Analytical trouble-shooting, problem-solving and decision-making: This seminar presented again methods and techniques facilitating choice and use of relevant data which will make it possible to solve problems, prepare decisions and recognize critical situations ahead of time. Furthermore, the seminar showed how complex situations can be split into parts which can be handled easily.

The four thinking models mostly used in daily routine work, i.e.

- Determining a reason troubles;
- Choice of best possible measure;
- Realizing problems ahead of time;
- Splitting complex situations into parts

are being optimized based on rational techniques.

Therefore, the following questions were put before seminar participants:

- What is being done in case of troubles?
- How can troubles or deviations best be described?

The question as to the "reason for the troubles" and determining and checking this reason was also discussed.

As far as Decision-Making is concerned,

- within the framework of a decision-analysis,
- the description of the reason for a particular decision,
- the preliminary decision and, finally,
- the checking of negative results

were discussed.

Recognition of future problems under the heading "What could go wrong if certain measures are taken?" were described, based on an analysis of potential problems.

Knowledge of this "ATS"-method is of special importance in the field of MAINTENANCE, in order to increase efficiency.

### 3) Energy conservation

Attention was not given to energy conservation because the value of energy was small compared to the cost of investment until the first oil crisis. Since then much effort was spent on energy conservation while the saving of 1% energy consumption was equivalent to saving 0.5% of the

total refinery operations. Several methods were developed for energy monitoring and savings. The utility consumption report in which data concerning

- fuel gas
- steam
- process water
- compressed air
- cooling water and
- electric power

are computed and deviations noted. Possible measures of energy savings can be found through:

- a high degree of heat-integration,
- low excess air in boilers and heaters,
- low stock temperatures,
- low steam inlet temperatures to coolers,,
- minimum steam loss,
- minimum radiation loss,
- minimum reflux ratio and stripping steam.

A first possible approach to energy saving is by improving operational conditions:

- Training of operation personnel and creating a situation of awareness of energy waste. This item needs a strong commitment of refinery management to deliver acceptable results.
- Better equipment: The choice of steam traps, burners, instrumentation and analyzers should also be made bearing advantages and disadvantages for energy consumption in mind.
- Better maintenance: The cleaning of burners and exchangers should be optimized. Insulation and refractory repaired as quickly as possible. Steam traps inspected on a regular basis.
- Improved operating conditions: Excess air monitoring and control, minimizing stripping steam, etc.
- Identify steam leaks: Inspection programme for steam piping and steam tracing.

Although energy cost is low at the moment, there may be opportunities to locate measures that have acceptable economics. A systematic check on heaters and pre-heat trains must represent an interesting pay-back.

Practical cases of energy savings at Schwechat refinery were studied and the impact of a certain number of measures on the operating costs like:

- Improved training of personnel;
- Better selection of equipment;
- Strict maintenance procedures;
- Improved operating conditions;
- Reparation of steam leaks.



4) Visits and Practical Demonstrations

a) Visit of Schwechat Facilities:

During the second day, a presentation of the refinery's activities and the organization of OMV was made by the Refinery Manager, and a visit through the refinery facilities was arranged.

b) Visit to Voest-Alpine, Linz

After a welcome by the Voest-Alpine management in Linz and an introduction to Voest-Alpine's Department for Industrial Services, a visit was arranged to the departments of:

- Apparatus Engineering
- Welding Engineering and Technique
- Non-Destructive Material Testing
- Maintenance Services and Systems
- Measurements for Energy Conservation.

c) Visit to Austrian Federal Economic Chamber

A presentation was made by the representatives of the following companies:

- Simmering-Graz-Pauker AG
- Wagner-Biro AG
- Ochsner GmbH
- Leobersdorfer Maschinenfabrik AG
- Hörbiger Ventilwerke AG
- Alin-Union AG

A Question and Answer Session was organized with suppliers and personal contacts have been established between the representatives of refineries and vendors. For a smaller group a visit was arranged to Rosenbauer - Linz.

d) Visit to OMV Central Technical Department Gerasdorf with guide and extensive explanations.

e) Visit to Central Welding Institute (Schweisstechnische Zentralanstalt, SZA), Wien.

E. Experience Exchange Group - Question and Answer Session

Two days were dedicated to the Experience Exchange Group and Questions and Answer Session held at UNIDO Headquarters.

The compilation of the questionnaires sent by the participants regarding the status of their respective plants and problems faced in their daily duties was studied, and to a certain extent, answers, solutions or recommendations were made.

Beside the expertise of OMV representatives, namely Messrs. Maier, Miglitsch and Hornasek, we have benefitted this year from the presence of Mr. David Day, Manager of Inspection Services, UOP Processes, who is really the man on spot, sent out by his firm to look at problems encountered here and

there by different customers. In this respect, the cases occurred recently and reported, the basic data and solutions to the problems were of great interest to the participants.

The list of questions raised as attached as Annex I. An assessment of the workshop was made by the participants and the results are attached as Annex II. Annex III is the list of participants with complete coordinates.

#### F. Closing Ceremony

Before giving the floor to the different representatives attending the final session, Mr. Derrough gave the background of the three-week workshop and summarized the main achievements. First of all this workshop could not have reached such positive achievements without the dedication of OMV staff and management. On the other hand the generous contribution of the Austrian Government has made possible once more the organization of this sixth workshop and the arrangements made by the Chamber of Commerce with different manufacturers and vendors will possibly lead to a fruitful commercial relationship between developing countries and Austrian suppliers.

The floor was then given to Mr. G. Patterson, Director, Officer-in-Charge of the Department of Industrial Operations, who complimented the participants on their seriousness and permanent interest judging by the number and quality of questions raised, as well as the lecturers from OMV and the sponsor organizations. A certificate of attendance was handed over to each participant. The different lecturers from OMV also received special certificates as recognition from UNIDO for their permanent dedication.

Mr. G. Krepela from the Permanent Mission of Austria to UNIDO, Mr. J. Berger, the Manager of the Schwechat Refinery, and Mr. K. Haas from the Austrian Federal Economic Chamber, all mentioned their satisfaction and their willingness to support similar activities of UNIDO in the future.

Name: Bao Naizhao

Sinopec, China

1. How to prevent the pipeline from oil acid?
  - 1.1 the corrosion reason
  - 1.2 the measures:
    - 1.2.1 to improve the processing situation
    - 1.2.2. to replace the pipeline with better material: carbon steel? Cr-Mo steel? stainless steel?
2. The governments law on the pressure vessels.
  - 2.1 general
  - 2.2 There are some serious defects in the pressure vessels, specially in the main pressure vessels. How to solve these problems?
    - a. replace?
    - b. failure analysis and repair?
3. Suggestion:
  - 3.1 Visiting your refinery's computer-aided information system for maintenance.
  - 3.2 Visiting the condition diagnosis system in your refinery.

Name: I. H. Macauley

Sierra Leone

1. Displacement of trays in the flash zone of the crude fractionating column.  
How can this be stopped?
2. The refractory in the crude heater cracks and crumbles in certain areas.  
Patch repairs have not been effective. How can this be tackled?
3. Premature failure of mechanical seals on the gasoline stabiliser reflux pump. How can this be overcome?
4. Removal, handling and cleaning of heat exchanger tube bundles. We seek a safe and efficient method.

Name: Ephrem E. Mkude

Tanzania

1. Cause of gum leading to carbon formation of gasoline and kerosene unit heat exchangers train.
  - 1.2 How could it be avoided?
  - 1.3 Once formed how could the carbon deposit be removed chemically?
2. What could be treated as purely maintenance cost in maintenance works in a refinery or petrol chemical plants (i.e. what is to be maintenance cost and projects cost) with the aim of reducing maintenance costs.
3. How is sulphur removed from flue gases and what are the low term advantages (economic) apart from reducing air pollution?
4. How do different types of crude oil affect the working condition of distillation columns?
5. How is ground flaring achieved and what are the advantages?

Name: Thani Al-Sharyani

United Arab Emirates

At our refinery cooling water is supplied from sea. This we have some shells and fouling problems. Chlorine is dosed on two types of injection. Continuous and shock dosing are used at our sea water intake.

Nonetheless still fouling exist at down stream consumers.

Therefore we interesting to here and share the trials and solutions to foresid problem.

Name: Egana Ismael

Uruguay

Additionally the paper submitted (copy) I aks for:

6. Have you corrosion training (PAL tape for instance)?
13. Problems setubing heat exchangers with titanium tubes, and ..... used.
19. Submarine pipe corrosion; solutions.
20. Why did you introduce mechanical inspection; how are its functions and how it works.
21. Gas compressors seals.
22. Insulating materials: a) for pipes and valves  
b) for furnaces  
c) for columnes and vessels  
d) for tanks
23. Columne ..... on used steel sheet.
24. Fire fighting pumps and motors (explosion or electric)

### BRIEF HISTORY

A.N.C.A.P. ( Administración Nacional de Combustibles, Alcohol y Portland) is a state institution that has an Oil Division and a Petroleum Refinery in La Teja, Montevideo, Uruguay's capital.

In 1937 the first topping unit started up and in 1950 the second, including a vacuum unit. In 1961 the third topping unit started up, 58.000 m<sup>3</sup>/day, including a vacuum unit. From 1962 Catalytic Cracking and Vapor Recovery units went into operation.

In 1963 Catalytic Reforming and Naphta H.D.S. units, in 1965 Middle distillates H.D.S. and Fuel Gas treating units went into operation.

In 1967 was revamped the first topping unit, adding a vacuum tower to process asphaltic crudes.

Because of the recession in our country the first and second topping units are out of service.

### Subjects of special interest

We have many problems in the maintenance, plant inspection, energy conservation, trouble shooting, personnel training, equipments, external contractors, parts and materials supply, etc. in our refinery; we include a brief description of them without a detailed treatment, that will be made in the workshop session.

We suppose that the best experience would be gained seeing: the refinery, with its maintenance problems and solutions; the repair shops working with its equipments, tools, work methods, personnel training facilities; the inspection organization, problems, solutions, equipments; the maintenance equipments factories; the refinery equipment factories.

### Specific problems

- 1) Elliott "29 MS" Model, "29 MSB-7" Size H.R. Gas Recovery Compressors main repairs; lubricant oil pass to gas; shaft chromium plate; multiplicator noise gears by teeth corrosion.
- 2) Franco Tosi 4500 KW, 3000 RPM, no 4221, Year 1960, action - reaction condensation type with plant steam extraction turbine: maintenance, regulation; nozzles cleaning; labyrinths change; vacuum equipment; ejectors or vacuum pump.
- 3) Crude furnaces inspection, mandrels control, cabinet type vs. vertical type maintenance and operation; decoking specifications for both types, asphalt burning.
- 4) Own electric generation or external supply for energy conservation.
- 5) Predictive maintenance organization, equipment, results, etc.



- 6) Maintenance personnel training organization.
- 7) Maintenance personnel functions, distribution, repair shops duties assignments: particular quantities; personnel shifts of several occupations organization.
- 8) External maintenance contract enterprises in many works: programmed turnarounds, emergencies, hourly repair shops (latheshop, boilermaker, pipework, electric motors rewinding); enterprise training; quality control; labor rates.
- 9) Spare parts and materials stock controls; minimum stocks determinations; acceptance controls.
- 10) Emergency maintenance: pipe hoops, plastic-metallic elastomers use and its refinery standards approval and results; fluid operation (steam, oils, water, gasses, pipe, flange, equipment, leakage sealing).
- 11) <sup>ACEC</sup> 3"BFH-A BST6/water boiler feed pumps, gripping when stop.
- 12) Hydrodesulfuration unit compressor types: reciprocating or rotative; maintenance problems and solutions.
- 13) Heat exchangers, condensers and coolers, materials tube selection; specialy discussion between: aluminium-brass, copper nickel 70-30 or 90-10, titanium.
- 14) Boiler tubes metallographic replicas inspection method.
- 15) Electronic or pneumatic instruments selection; maintenance results; costs; operation; pneumatic to electronic change possibility.
- 16) Pipes, and equipment (external and internal) corrossion protection: paints recommendation for sea water use and petrol products production.
- 17) Several welding procedures and personnel training.
- 18) Equipment information required about:
  - a) underground pipe leakages location
  - b) thermography
  - c) quickly metal alloy determination
  - d) fibroscopes application for inspection
  - e) shaft chromium plate and bearing babbit adherence tests and standards applicable.
  - f) pumps, compressors, turbines, hot alignment and non contact vibration detection
  - g) cranes, hoists, derricks, etc.
  - h) face flanges pipe, heat exchanger, tower, etc. mechanization "in situ"
  - i) vessels, towers, furnaces toxic gasses exhausters

- j) bench safety valve tests
- k) heat exchangers assembly and disassembly equipment
- l) heat exchangers head plates multiple drilling
- m) heat exchangers, furnaces, boilers expansion mandrels
- n) underground electric wire faults location
- o) antivibration(reinforced) incandescent lamps
- p) high temperature electric motor insulations materials:  
wires, separators, etc.
- q) freon leak detectors
- r) circuit breaker contacts welding
- s) welding machines for field or shops
- t) shop repair tools and equipments
- u) maintenance computer programs
- v) sandblasting, shotblasting cleaning.

Name: Humeid Munir

Jordan Petroleum Refinery

**I. In Maintenance and rotating machinery:**

1. Experience in PREDECTIVE MAINTENANCE how you can predect a mechanical seal life, bearing accidental failure, how economical installing probes and investing monitoring equipment, which is safer for continuos operation preventive or predective?
2. Experience in non asbestos material is it dependable for sealing surfaces. Also how others manage to stop leaks from light and heavy gas oil flanged piping, valves stems and exchangers. Flexicarb gaskets reliability.
3. Pumps sleeves rebuilding by coating with ceramic (cold spraying max surface temp 500 C) has this been succesfull?
4. How often you inspect each part of your reciprocating compressor in hydrogen service what are the findings?
5. For platforming centrifugal compressor or power generating turbine, types of speed controlers and fluctutation limits.
6. Do you try to repair white metal bearing? Have you casted one? How did you overcome Separation?
7. Manufacturing of spare parts procedures and tools what experience others have in this field.
8. We run the standby pump 24 hrs every week. Its bearings or mechanical seal life has not been extended than the life of running one. How you treat your standby equipment.

**II. In Inspection:**

1. Laminations (voids) in pressure vessels acceptable limitr and codes, also service.
2. Test pressure for equipment (Exchangers) during Turnarounds i.e. 1.5 operating pressure or design pressure?
3. Regardles of codes and regulation how long a steam generator (Boiler) may remain in service without Inspection also boiler safety valves? What parts of boiler should be seen annually.
4. Duration of overhauls for units and how long refiners have extended the number of years for units in operation.

5. Hydrogen reformer tubes header and pigtails what kind of stock level should be maintained.
6. In hydrogen plants, Union Carbide adsorbers how often should be dumped and vessels been inspected.
7. Building up (by welding) the corroded sections on pressure vessels i.e. permissible areas and restrictions also warnnings for outside patching.
8. Refractories and their application, what is new and can be easily applied.

### III. In Energy Conservation:

1. The Co boiler troubles
2. Infrared viewer how much realable for steam traps checking and how often should be used.
3. The pre heaters before refinery furnaces stacks how often you open the bypass, what troubles you face with internals.

Name: John Evelyn

Trinidad

1. Convection Bank Finned Tubes  
How do you inspect from a corrosion point of view -  
We remove one tube every six years, split the tube and  
examine it - Is this a normal practice ?
2. Can I get a copy of the sandblasting Standard SA<sub>3</sub> or  
the address of the Swedish Institution.
3. Decoking by Sand Testing - Procedure
4. High Temperature Paint - a) Specifications  
b) Manufactures
5. Can you give me specifications for your FCCU Expansion  
joints a address of Manufactures
6. VACUBLAST Equipment -  
- is literature on equipment available or  
manufacturers address.
7. Information of protective lining of cooling water lines +  
cooler  
a) Technical literature  
b) Manufacturer
8. Copy of curves and data explained during the lecture.

The following problems are encountered by Aden Refinery:

1. Straight run benzene (SRB) overhead condensers:

Tubes are being replaced almost every six month. Material of tubes are seamless, solid drawn, Aluminium Brass to ASTM B. III, No 687 or BS 2871, PT, 3, C2 110 heat treated to condition. But these tubes replaced by Seamless, solid drwan, anneated, 66/30/2/2 Copper Nickel Iron Manganese otherwise to B.S 1464 which are given a good result as those tubes are better then they old tubes.

2. Blowdown stack

The stack internally corroded. Material of the stack is to BS 1501-151-Grade B. the first 2 strakes are 5/16? thick plates, and the other 6 strakes are 1/4 thick plate with 28 ?? hight from the stack drum. Blowdown stack was replaced by new one on 1977? and replaced again on 9/1/1988.

3. Boiler Tubes

- a. The boiler tubes failed from time to time due to superheater .... pinholes and that happened during the stream. Those coils? cannot be checked aultersonicly because the spaces between the tubes are to narrow.
- b. Air heater tubes discrage ends always blockage.

4. C.O.D.U.S heater convection bank tubes

From time to time a pinhole appear suddenly at the convection bank tubes. Those tubes cannot be checked aultersonicly because the spaces between the tubes are to narrow.

5. Stabilizer Reboiler

The stabilizer tube bundle always ..... in the shell and it does not come out of the shell easily.

Name: Saleh Ali Ahmed

P.D.R. of Yemen

1. Boiler air superheater tubes blockage from the discharge ends.
2. Blowdown stack always corroded internally. This stack was replaced in 1979 and again replaced in 1987.
3. SRB condensor tubes changed yearly and also it is blockage by sea growth.
4. C.o.ud,s heater convection bank tubes pinholes appear from time to time as those tubes cannot be checked by aulterasonic m/c.
5. We meet difficulties in spare parts for old pumps and turbines.
6. Stabilizer reboiler bundle seized in the shell and it dose not came out easily from the shell.

Name: A. Boahene

Ghiap Oil Refinery

1. Leakages at the expanded tube ends to the headers at the radiant zone section, mainly at the inclined zone north of furnace.



Name: Yousif Salih Ahmed

GPC-GAT-Pipeline  
Sudan

1. Is there any new technique regarding corrosion suppression i.e. to minimize corrosion especially in tanks and pipes of finished products?
2. Steps to follow when commissioning new tanks. Best tests to be carried out, in addition to the already known standards.
3. Suitable NDT for high pressure weldings.
4. Is there any recent technique for detection of external and internal corrosion in burried coated/wrapped pipes?
5. Instruments used for on-site balancing.
6. Best steps to reduce maintenance - operation conflicts.

Name: Ibrahim A. Al-Jassim

NODCO, Qatar

1. Which techniques are used to monitor rotating machines vibration? (It would be very much appreciated if catalogues were provided).
2. What is the inspection programme for rotating machines?
3. What is the cleaning of centrifugal compressors?
4. Is it possible to wash a compressor with chemical solvents without opening it? How can this be carried out?
5. Which procedure is followed in alignment in rotating machines?

Name: Yousif Suliman Hamid

General Petroleum Corp.  
Sudan

1. How to reduce corrosion in high humidity areas?
2. Use of salt-water in firefighting system causes bad corrosion. How can this be reduced?
3. How to determine corrosion rate more specifically?
4. I want more information about the predictive maintenance and how to apply it. Examples would be appreciated.

Name: Abu Boahene

GHAIP, Ghana

Leakages at the expanded tube ends to the headers at the radiant zone section,  
mainly at the inclined zone north of furnace.

Name: John Evelyn

Trinidad & Tobago Oil Co. Ltd.  
Trinidad & Tobago

1. What methods are used to measure internal corrosion in underwater or long buried section of pipelines?
2. Are there any international standards for fire protection of refinery process plants and tank farm areas.

Background: Trintoc's Pointe-à-Pierre Refinery previously belonged to the Texaco group who carried their own insurance. We are now faced with high premiums from our insurers who are requesting improved fire-proofing and containment walls around large volume process vessels.

3. What has been the experience/success of centralized planning (computerized) in large refineries covering an area of 6 km<sup>2</sup> and a work force of 600 craftsmen?
4. Has there been any experience with computerizing an existing work order system and management information system and if so how was it approached?
5. The Schwechat refinery appears to have both a centralized and decentralized work force - what percentage of the personnel is in either group?
6. Is there an inspection frequency for off-site equipment i.e. tank farm pipelines?
7. What is the modern practice in the use of mechanical seals, single seals, tandem seals? Materials of seal faces?

ON

**MAINTENANCE AND PLANT INSPECTION IN PETROLEUM REFINERIES**

**March 7 to March 25, 1988**

---

We would like to improve performance and would appreciate your help. Please complete this questionnaire and return it to us. Your assessment will be ANONYMOUS.

Please check off correct answer:

1. Was it your own desire to participate in this WORKSHOP ?

YES	12	NO	1	PARTLY	5
-----	----	----	---	--------	---

2. Was the time allotted completely not completely not long  
to:                           adequate       adequate       enough

Lectures	0 8	0 7	0 3
Discussions	0 9	0 5	0 4
Exchange of experience	0 6	0 6	0 6
Relaxation	0 14	0 1	0 3

3. Have the themes discussed been too extensive in relation to available time:

too extensive	0 4
adequate	0 11
not extensive enough	0 3

4. Were the themes presented

12	a) helpful to you in your job
6	b) only partly helpful
0	c) not related to praxis/too theoretical

5. As a whole, has this WORKSHOP been

7 a) very valuable to you and your job

10 b) valuable

our Refinery is too old and not computerized

1 c) hardly valuable, because .....

d) without any value, because .....

6. Please grade organization and administration of this WORKSHOP.

7	5	4	1	1						
1	2	3	4	5	6	7	8	9	10	
very good									bad	

7. Suggestions as to how similar WORKSHOPS could be improved:

.....

.....

.....

.....

8. Which additional themes should be treated ?

.....

.....

.....

.....

Thank you for completing this questionnaire !

To point 7. Suggestions as to how similar WORKSHOPS could be improved:

- It was very good.
- I suggest two days for the participants to discuss their problems with the panel and exchange their experience in particular field instead of one day.
- I think Saturday every week should be working day and Sunday and Monday to be weekend, so the concentration will improved.

Participants should be good english speaking and understanding.

ÖMV have done their best, but I think there should be tech. cases and solutions.

Maybe 4 weeks with more details will be very good.

- Discussion between the participants and the lecturers must be after the every conference.
- In fact, as the lecture and discussion time was not sufficient particularly for maintenance and plant inspection, I feel it necessary, in the future to be a little longer that is at least 4 weeks. For the rest it is enough.
- Documents must be adequately translated into English.  
Time for afternoon lectures must be around 1.30 pm for participants to have enough relaxations.  
Future participants must be encouraged to have a short stay at an area (workshops or planning office) of his interest, so as to get an insight into the type of job be done at ÖMV as compared to his.
- It is better to break down the workshop into three workshops covering the same subjects to have time and specific fields of interest.
- Participants must be informed well in time, they must also be able to communicate in the medium if tuition.  
A little more time to be devoted to visit refinery plants.
- Increase time for practical experience in the workshops and plants.  
Preferably the workshop should be held in spring time, just before summer.
- My suggestion is to give sufficient time for various topics to be discussed in the similar workshops.



- I think better is the program dependent upon especially, I means separate all people each in his kind of job.  
I think it would be better if the program is 6 week.
- Non, except during summer time.
- Better selection of participants for better experience exchanges.  
Representatives of austrian companies should be qualified enough for clear demonstration.
- Sufficient time should be allowed to instructure to say what he has.  
The time given to maintenance of rotary m/c was not enough.
- Different refineries conditions must be taken under consideration, so that more close othernes can be presented which are more practical.
- If possible to access the time another one week it would be very good. Anyway the seminar was very good.
- More anticipated notice for our country organization about the beginning of theese workshops.  
Making partial teams of participants, more visits to the refinery and workshops and work fields seeing.  
Discuss the matters only after the lectures.
- Headlines should be presented firstly then discussions follow.  
Questions should be limited during lectures however about 40% of the time should be allocated for discussion.

To point 8. Which additional themes should be treated?

- All areas were covered.
- If the lectures extend to discuss the problems in other refineries and to find solutions for the problems for all matter.
- This is depends upon the compositiory the participants, that is if they are managerial staff, a lecture on management effectiveness and production quality themes can be included, or the lectures on maintenance and plant inspection can be given separately.
- It is very much required for the third world to have more informations about the techniques of manpower development in the future and ways of best organization systems.
- Technical services and quality control process operations, stores management.
- Safety in the workshops and in the process unit could be added.
- Incrementation of mechanical problems treatment.
- The program is good, but I think it is better if there is included more practical.
- Spare parts.  
New maintenance equipment same as tools and inspection equipment.
- Maintenance of old refineries and attempts to improve at least costs.  
Salt water.
- All the discussion points from all the group should be written and gave them. Because most of time is not enough to discuss on all questions.
- Most overseas, undeveloped countries suffer from shortage of spares and obtaining spares for obsolete equipment. Strategies in dealing which this problem could be discussed.  
A update course for senior (experienced) inspectors in modern techniques.

- In my opinion operation dept. and some of their cases and problems relating to plants should be presented.

Group study cases tech. should be more than one time.

Some of the cases at ÖMV need to be updated, for the case of inst. lecture it was written 1983.

Even though with above comment ÖMV have done a good job.

Also UNIDO have done a good job and good arrangement.

UNITED NATIONS  NATIONS UNIES

**WORKSHOP ON MAINTENANCE, PLANT INSPECTION AND ENERGY CONSERVATION**

**IN PETROLEUM REFINERIES**

**Vienna, 7 - 25 March 1988**

**FINAL LIST OF PARTICIPANTS**

**CHINA**

**Bao Naizhao**

**Vice-Chief Engineer  
Changling Refinery, SINOPEC  
Yueyang**

**Hunan Telephone: 23611  
China Telex: 994007**

**CUBA**

**Alejandro Abreus Aneiros**

**Mechanic Engineer  
Nico López Refinery  
Vía Blanca y Belot, Regla  
Ciudad Havana**

**Telephone: 90-8336  
Telex: 51610**

**ETHIOPIA**

**Tilahun Mulu**

**Technical Manager  
Ethiopian Petroleum Corporation (EPC)  
Addis Ababa**

**Telephone: 445206  
Telex: 21054  
Cable: REFINERY ADDIS**

**Tadesse Girma**

**Division Head  
Ethiopian Petroleum Corporation (EPC)  
Address as above**

**GHANA**

**Joseph Adu Boahene Kontor**

**Chief Maintenance Planning Officer  
Ghaip Oil Refinery  
P.O. Box 599  
Tema, Ghana**

**Telephone: (0221) 2881-4 Ext. 265  
Telex: 2005/2011 GHAIP**

**JORDAN**

Munir Abd M. Humeid  
Head of Maintenance Department  
Jordan Petroleum Ref. Comp.  
P.O. Box 176  
JOPETROL  
Zarka  
Telephone: 9/911211  
Telex: 21246 JO

**LIBYA**

Nasser F. Musa  
Inspection  
Tobruk Refinery  
Naser El-Sharif  
Tobruk  
Telephone: (021) 606599  
Telex: 50076 M M T N LY

Fathalla A. Abed  
Mechanical Engineer  
Tobruk Refinery  
address as above

**MOROCCO**

Abderrahman Boukaidi  
Electrical Engineer  
Office National d'Electricité  
O.N.E./Dist. St./Ex  
Rue Aspirant Lafuente  
Casablanca  
Telephone: 245941, 245955  
Telex: OFELEC 22780 M

**NIGERIA**

B. I. Obialo  
Nigeria National Petroleum Corporation Refinery  
P.M.B. 44  
Effurun - Warri  
Telephone: (053) 200050-9 Ext. 434, 427  
Telex: 43455 NNPCRW NG

**QATAR**

Ibrahim A. Al-Jassim  
National Oil Distribution Co.  
Umm Said-Qatar  
P.O. Box 550033  
Telephone: 770651

**SAUDI ARABIA**

Mohamed Mubarak S. Al Barharith  
Field Maintenance Manager  
Jeddah Oil Refinery  
P.O. Box 1604  
Jeddah 21441  
Telephone: 637-0045  
Telex: 601150 PTMN SJ  
Cable: ALMISFAT

**SIERRA LEONE**

I. H. Macaulay  
Refinery Maintenance Engineer  
Sierra Leone Petroleum Co. Ltd.  
P.M.B. Kissy Dockyard  
Freetown  
Telephone: 50391  
Telex: 3246 PETREF FREETOWN

**SUDAN**

Yousif Salih Ahmed  
Acting Maintenance Manager  
General Petroleum Corp. (Pipeline)  
P.O. Box 1704  
Khartoum  
Telephone: 78219  
Telex: 22649 Pipes  
Cable: PIPELINE

Yousif Suliman Hamid  
Mechanical Engineer in Design and Projects Section  
General Petroleum Corp.  
Khartoum  
Telephone: 75693  
Telex: SD 22638  
Cable: PETRO SUDAN

**TANZANIA**

Ephrem E. Mkude  
Senior Maintenance Engineer  
TIPER  
P.O. Box 2608  
Dar-es-Salaam  
Telephone:  
Telex:

**TRINIDAD AND TOBAGO**

John Evelyn  
Maintenance and Construction Manager  
Trinidad and Tobago Oil Company Ltd. (TRINTOC)  
Pointe-à-Pierre  
Trinidad, West Indies  
Telephone: 1-809-65804220  
Telex: 39367  
Cable: TRINTOC, PAP

**UNITED ARAB EMIRATES**

Thani Saeed Al Sharyani  
Shift Engineer  
Abu Dhabi National Oil Company  
Hydrocarbon Processing Directorate  
Shaikh Khalifa Street  
ADNIC Building  
Abu Dhabi  
Telephone: 335800  
Telex: 24232 ADNOIIP EM  
Cable: "REFNOC"

**URUGUAY**

**Ismael Ignacio Egaña Esponda**

**Chief Engineer Maintenance Shops  
ANCAP (Administración Nacional de Comb. Alcohol  
y Portland) - Oil Division  
Humboldt s/n  
Montevideo**

**Telephone: 39 62 13**

**Telex: 23168**

**YEMEN**

**Saleh Ali Ahmed**

**Materials and Records Engineer  
Aden Refinery Company  
Little Aden  
Aden**

**Telephone: 76282**

**Telex: 2213YD REFINERY**

**Cable: REFINERIES, ADEN**

**Abdulla Othman Salem**

**Section Head of Refinery Process Units  
Aden Refinery  
Little Aden  
Aden**

**Telephone: 76304**

**Telex: 2213YD REFINERY**

**Cable: REFINERIES, ADEN**