

# **REPORT ON**

**IUPAC-UNESCO-UNIDO**  
Safety and Environmental Training Fellowship.

**AT SASOL CHEMICAL INDUSTRIES,**  
Sasolburg, Republic of South Africa.

June 2 - June 16, 2002.

**BY**

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## IUPAC-UNESCO-UNIDO SAFETY TRAINING AT SASOL, SOUTH AFRICA JUNE 2 –JUNE 16, 2002.

While industries in developed countries are introducing sophisticated safety measures covering operational, health and environmental aspects in close relation with Government and the public, the gap between the developed and developing countries in safety education, research and implementation of technical measures is widening. The increase in Chemical Production and consumption in the developing world makes it essential to promote interactions to disseminate state of the art knowledge on safety and environment protection in chemical production.

The above forms the basis for the coming together of IUPAC (International Union of Pure and Applied Chemistry), United Nations Educational Scientific and Cultural Organisation (UNESCO) and United Nations International Development Organisation (UNIDO) to develop a joint training program for safety and environmental protection, which allows safety experts from developing countries to learn about safety and environmental protective measures by visiting and working with plants of IUPAC company associates in the industrialised world.

I was privileged to be selected for the safety training program which started in 1993 and was accepted by Sasol chemical Industries in South Africa for two weeks training from June 2 to June 16 2002. The Sasol group of companies comprises diversified fuel, Chemical and related manufacturing and marketing operations. The core operations are complemented by coal-mining operations in South Africa and oil and gas exploration and production activities in Southern and West Africa.

In South Africa, Sasol converts coal into value-added synfuels and Chemicals through unique Fischer-Tropsch technologies. The group also refines crude oil into liquid fuels. From 2004 onwards, Sasol will also use natural gas as a primary feedstock in South Africa. My training visit took me to several of their facilities and offices at Sasolburg, Secunda and Johannesburg.

### Training Highlights:

My training at Sasol covered such areas as

1. Aspects of responsible care and integrated approach for SHE.
2. Occupational Hygiene.
3. Process safety management with emphasis on HAZOP awareness.
4. Material safety data sheets (MSDS).
5. Hazard Identification Risk Assessment (HIRA).
6. Top set accident investigation technique.

## Introduction:

The first day of the training was a corporate preview of Sasol activities with emphasis on safety, health and environmental practices by the company. This discussion was led by the General Manager of Sasol, Dr. Mike Rose at Corporate head office, Rose Bank, Johannesburg.

He emphasised management Commitment to best practice and continuous improvement, citing the Shell Sustainable Development annual report and Shell global solutions as Model contributions in the Chemical Industry Business.

Sasol's process safety framework is based on the American process safety management which is particularly applied in their American operations with consequent transfer to other operations. The performance is based on injury statistics using the United States based Occupational Safety and Health Administration (OSHA) definition on Injury classification.

The injury rate is used as an indicator on people personal safety. Other indicators used are fire explosions and emissions, for example;

- i. Ammonia or Chlorine emissions represent major hazard.
- ii. LPG cloud gas or vapour emissions.

Also used is the responsible care – an international program administered by countries chemical industries associations. The responsible care has 6 codes, 4 deal with things on site while the other 2 deal with off site issues. One of the off site issues of special interest is the product stewardship, which addresses what happens to a product from cradle to grave (lifecycle), for example, a company that produces pesticides should show interest in how customers handle disposal. The other issue under responsible care is Community Awareness which handles the anxiety of the community where operational facilities are located, this is particularly an area of concern in the developing World where agitation on anticipated consequences arising from activities, products and services of the Industrial process is quite volatile and could degenerate into loss of lives and more damages to the environment.

In the presentation of this report, an attempt is made at capturing some vital points in the various training highlights listed earlier so as to accurately present the nucleus of the report without the nitty gritty that may become an unnecessary burden on the reader.

## Aspects of Responsible Care & Integrated Approach to SHE:

Responsible care was initiated in Canada in 1984 and adopted by Sasol in 1994. It is a voluntary initiative by Industry to be proactive and respond to public concerns about the manufacture, transport, use of disposal of Chemicals and Packaging.

Main Purpose: An Internationally aligned set of fundamental safety, health and environmental values to which each responsible care signatory makes a voluntary public commitment.

Key Factors:

- Can be seen as the fundamentals of chemical industry ethic or philosophy for continual improvement in performance of all Safety, Health and Environmental aspects.
- It is considered to be the key to public acceptance.
- The guiding principles are essentially equivalent to the policy of a management system.

It has 10 guiding principles mainly

1. Conduct our operations in a manner which minimises adverse environmental impacts and protects the health & safety of our employees and the public.
2. Recognise and respond to Community concerns about our operations and our chemicals.
3. Promote the principles and practices of responsible care by sharing experiences and offering assistance to others who produce, handle, use, transport or dispose of chemicals.
4. Integrate environmental, health and Safety considerations into our planning for new products and processes.
5. Report information on relevant chemical related health or environmental hazards promptly to appropriate authorities, employees, customers and any affected sectors of the public and recommend protective measures.
6. Give advise to customers and other affected parties on the safe use, storage and transportation of our chemical products as well as the safe disposal of any residue and containers.
7. Increase knowledge by conductivity and/or supporting relevant research on the SHE effects of our products, processes and waste materials.
8. Co-operate with customers, authorities and affected parties to resolve problems created by the handling and disposal of Chemical substances considered hazardous.
9. Participate with government and others in developing laws, regulations and standards to safeguard the community, our employees and the environment and endeavour to ensure that such laws are based on scientifically supported data and/expert opinion.
10. Promote the principles and practices of responsible care by sharing experiences and offering assistance to others who produce, handle, use, transport or dispose of chemicals.

I have observed similarity in concepts of responsible care with best practise/continuous improvement drive associated with standards like ISO14001, OSHAS etc. This to me indicates a common fount in the pursuit of sustainable development and safety. It is a well known fact that in several production and manufacturing outfits, the core business is clearly defined and workers are expected to focus on achieving set objectives, for example, the objectives of the Royal Dutch/Shell Group of companies are to engage efficiently, responsibly and profitably in the oil, gas, chemicals and other selected businesses in the research and development of other sources of energy.

Several times this put a production staff on an edge to deliver by all means so as to keep the production figure high. The integrated Safety Health and Environment (SHE) concept seeks to bring this same production personnel trained on SHE issues as to incorporate same in ensuring that standards are not relegated to the background in the search for production boost.

The era of production figures at the detriment of SHE is past and any company and organisation that will experience goodwill of the people, license to operate and perfectly link all key business drivers must not pay lip service to SHE. Sasol makes use of NOSA (National Occupational Safety Association).

Another practical demonstration on safety at Sasol is the short video that gives direction on expected conduct at sites emergency response and other safety issues. It is compulsory for all new entrants, visitors to watch this film which last for about 20 minutes and forms a strong basis for a permit to enter the factory.

On the Environmental side, Sasol is involved in monitoring parameters so as to ensure compliance to standards. I will highlight part of my observation on the monitoring and waste management as conducted by the company.

Sasol uses a system for effluent and storm water monitoring which uses probes linked to computers and inserted in drains and various sampling points. Deviations from expected values produces an alarm and action is taken by manual sampling for further test and corrective action.

Apart from sensor monitors, manual sampling is carried out every 4 hours and analysed in the Environmental laboratory with appropriate PPE worn by the analyst. PH, Connectivity, Sodium and cyanide analysis are given close attention.

Usually an on-line sampler picks the effluent and storm water every 30 minutes for a 24 hour process. Each cycle is emptied at a fixed time at the expiration of 24 hour cycle and a new cycle begins. If the parameter indicates that the water is out of specification, the shift manager/effluent operator contacts the plant to investigate the problem and rectify as soon as possible.

On a larger perspective about 600 different parameters are carried out in the process lab before the water used for various purpose is discharged to the river. There is also an independent Company which has 54 bore holes inside and outside the factory carrying out ground water monitoring. All the results are reported to the department of water affairs monthly who are very strict on delivery.

Waste generated as a result of the activities, products and services are segregated and disposed according to expected guidelines. There is a permit from government for every type of waste generated. The company has a waste tracking method that puts a control on all waste generated. When dumpsites are full, it is covered and rehabilitated according to law while the remediation team carries out remediation of impacted areas.

Sasol is shifting from coal to natural gas processing which will introduce a more environmental friendly technology.

### Occupational Hygiene:

Sasol focuses on 5 stress categories, namely:-

- i. Chemical - - - e.g. Benzene exposure
- ii. Physical - - - -e.g. Noise, illumination etc
- iii. Ergonomics - - Looking at the relationship between people and their working environment, including machinery, computer systems e.t.c
- iv. Psychological - - - More of a psychologist work, understanding how people's mind works
- v. Microbiology - - - Handled by the medical team and particularly focused on the sewage workers.

At every point the occupational exposure levels are taken into account and the nature of hazards identified with a particular task determines the priority stress management for specific persons/team. For example, office staff going for audiometric test, staff exposed to benzene going for blood and urine test.

As a result of the carcinogenic nature of asbestos fibres, all new projects in Sasol do not use asbestos.

There is a health risk matrix that is used to determine the qualitative, quantitative exposure and risk score for health. The higher the consequence the greater the number on the matrix, similarly the more the exposure, the greater the matrix number. For example, death could be the highest consequence and carries a higher number while a situation with no incapacity expected during normal working conditions apart from minor health effects with no lost time carries the lowest value.

Using the risk score of High, Medium and Low determines what action to follow.

Risk Scores(RS)	Action.
High(H)	<ul style="list-style-type: none"> <li>• Immediate action required.</li> <li>• Monitoring should be conducted immediately to introduce interim control measures.</li> </ul>
Medium(M)	<ul style="list-style-type: none"> <li>• Risk requires urgent attention as soon as possible.</li> <li>• Monitoring of risks required.</li> </ul>
Low(L)	<ul style="list-style-type: none"> <li>• No immediate action necessary.</li> <li>• Risks currently under control, but requires regular revision. Monitoring not a requirement , but left for the assessments teams directions.</li> </ul>

### HAZOP Awareness.

HAZOP stands for hazard and operability study and was developed in the United Kingdom by Trevor Kletz, but the technique only started to be more widely used within the chemical process industry after the Flixborough disaster in which a chemical plant explosion killed 28 people, many of which were ordinary householders living nearby. Through the general exchange of ideas and personnel, the system was then adopted by the petroleum industry, which has a similar potential for major disasters. This was then followed by the food and water industries, where the hazard potential is as great, but of a different nature, the concern being more to do with contamination rather than explosions or chemical releases.

It is an aspect of process safety divided into seven steps as follows:-

1. Conceptual HAZOP
2. Scanning HAZOP
3. Main HAZOP
4. Sub systems HAZOP
5. Pre-Start-Up-Check
6. Post Start-Up Audit

The final stage is 6 months after the plant has started, steps of HAZOP are linked with the project (Step 7)

Steps 1 to 4 are the engineering HAZOP.

At the conceptual stage questions that address key business decisions, risks and viability are handled. For instance, a chemist setting up an ethylene oxide plant. What are the risks? Is it viable etc.

The scanning HAZOP handles the process flow diagram (PFD)

The main HAZOP addresses the mechanical flow diagram (MFD) giving details and this can take 3 weeks or more. The MFD is composed of several professionals including the design team, mechanical, civil, electrical, plant, personnel etc. At the end of the MFD stage, the compressor is handled as a sub system designed by a company outside (A package unit).

Usually guidelines are available which helps to check out deviations that can exist. It is advisable. It is advisable not to undertake a project going for cheap things that constitute a hazard like in the case of a petroleum exploration platform that collapsed in Asia due to a poor decision to go for a cheap facility at the expense of safety.

Material Safety Data Sheets (MSDS).

Material Safety data sheet is a means of transferring essential hazard information (including information on transport, handling storage and emergency actions) from the supplier of a chemical product to the recipient of the product. It may also be used to transfer this information to institutions, services and other bodies that play a role in dealing with the chemical product.

In order to establish uniformity, certain requirements have been laid down as to how information on the chemical product shall be given (for instance the wording, numbering and sequence of the headings). All products have a chemical abstract service (CAS) number and provide the chemical product information under the following 16 standard headings, the wording, numbering and sequence of which shall not be altered.

1. Product and Company Identification
2. Composition/Information on ingredients
3. Hazards identification
4. First Aid measures
5. Fire Fighting Measures
6. Accidental release measures
7. Handling and storage
8. Exposure Controls / Personal Protection
9. Physical and Chemical properties
10. Stability and reactivity
11. Toxicological information



12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information

Text in an MSDS should be written in a clear and concise manner. Commonly used phrases are recommended and should be in a language acceptable to the recipient. Authorities check section 15 of MSDS immediately there is an accident. Sasol divisions have several MSDS for their products.

Sasol solvents – 250 products

Sasol Agric. Including blends – 700 products

Sasol oil - - - - - 400 products

Sasol also has MSDS on the intranet where employees can check MSDS of products. The company is also looking at the future where a requested product to be ordered by a customer automatically generates an MSDS for the customer before delivery. Since several Sasol product orders are made on the internet and other business transactions have already commenced in this fashion, it is envisaged that this vision will soon materialise.

#### Hazard Identification Risk Assessment (HIRA):

This is a risk assessment tool that identifies hazards and enables risk to be plotted on a matrix. It operates on the following steps.

1. Subdivide division in logical units, for instance, identification of different sections in a department and various work carried taking note of the equipment, accessories etc
2. List the hazards in each of these logic units using the check list.
3. Determine the consequence factor (worst case scenario)
4. Determine frequency from injury/incident and near incident history
5. Note all the above information on a risk register (control measures, actions required, responsible person and target date)
6. Plot the risks on the risk matrix
7. Finally review the process yearly or after any serious accidents/incidents

Usually a risk value is given which is normally the product of frequency of occurrence and the consequence. Both the frequency and consequence have a number score which is dependent on the severity of the consequence and frequency respectively. The higher the probability of an occurrence, the higher the number and the bigger the consequence of the accident which ultimately results to a higher risk value.

Generally, risks are classified into Low, Medium and High.

The risk matrix enables effective decision to be taken in order to give priority to higher risk areas. This tool is very effective in enforcing best practice on Safety, Health and Environment (SHE) and can be used to address any/all of S, H or E. It helps put controls in place to reduce risk to a level as low as reasonably practicable, with a target date and responsible persons in place to action required control measures.

In countries where the laws are enforced, for example in South Africa, investigators of accident request for the risk profile during investigations. An employer that cannot prove by objective evidence that HIRA is carried out on the jobs done by the employee is usually punished. HIRA like any other risk assessment tool is better carried out by a competent team which taps the resourcefulness of teamwork, in order to have a more accurate assessment.

Top Set Accident Investigation Technique:

It is normal in several settings to try to cut cost and invest little in safety issues. In a bid to be cost effective, we must make room to address as a matter of priority, a safe working environment and also support incident/accident investigation as a useful tool to put records right and prevent future re-occurrences of accidents. If we take a look at a typical statistical triangle as shown in figure A, it is usually tempting to underestimate the potential harm that could take place and involve a huge loss of money since the probability for fatality may not seem high compared to incidents recorded.

A look at Figure B clearly illustrates in the dotted lines, the effect that cost could play in the long run if and when the less frequent and worst case scenario occurs. See KEY : LWDC---lost work day case, REC--- records in hospital visits, INC---- incidents.

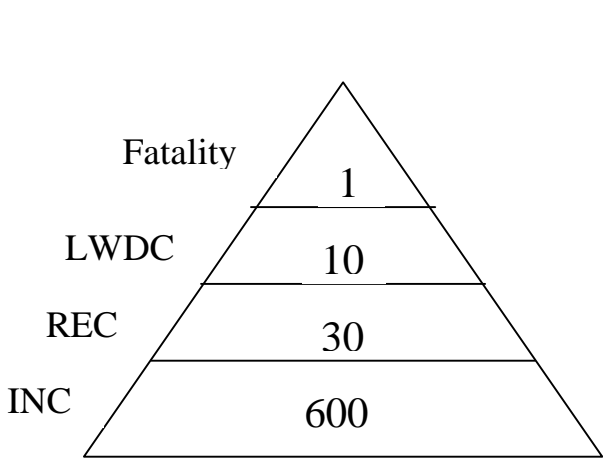


Figure A.

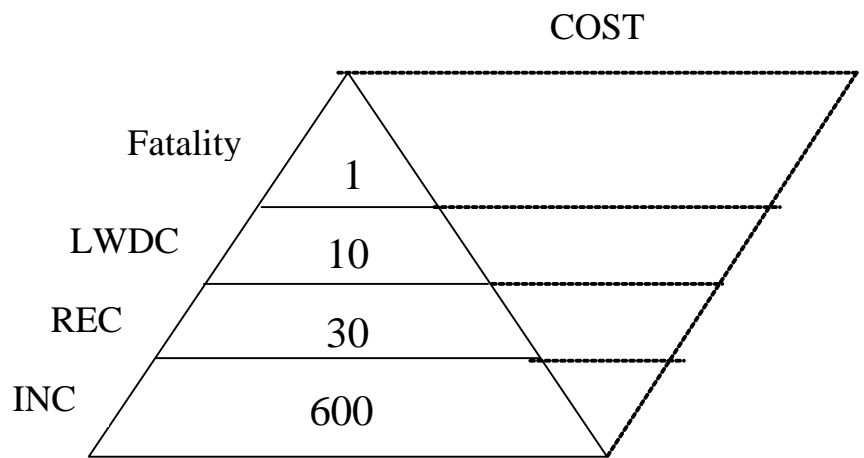


Figure B.

In Figure B, the message illustrated with the dotted lines is explicit showing the cost that could be involved as a result of accidents. It is important to note that the cost may also include a possible litigation and reputation damage.

Therefore, management in any reputable organisation must put resources together for safety projects and investigation of incidents that are reported. It is possible to have incidents reported by workers if the response by management is encouraging.

At Sasol, I attended a 2 day Top Set accident investigation course which was organised primarily for their staff.

Top Set was invented in Scotland and is accepted internationally to have carried good investigations on big aircraft accidents. It is a diagnostic system founded on basic and proven principles that enable detailed analysis to be conducted on any aspect of business from environmental releases, accidents and near misses to process failures. It establishes causes of failure, the sequences of events and the root causes that show where remedial action should be taken.

Timeline charting, Root cause analysis, Incident profiling are some of the techniques used. It works by gathering information through an interviewing methodology aimed at identifying the immediate cause, root cause and contributing factors.

#### The Investigation Highlights.

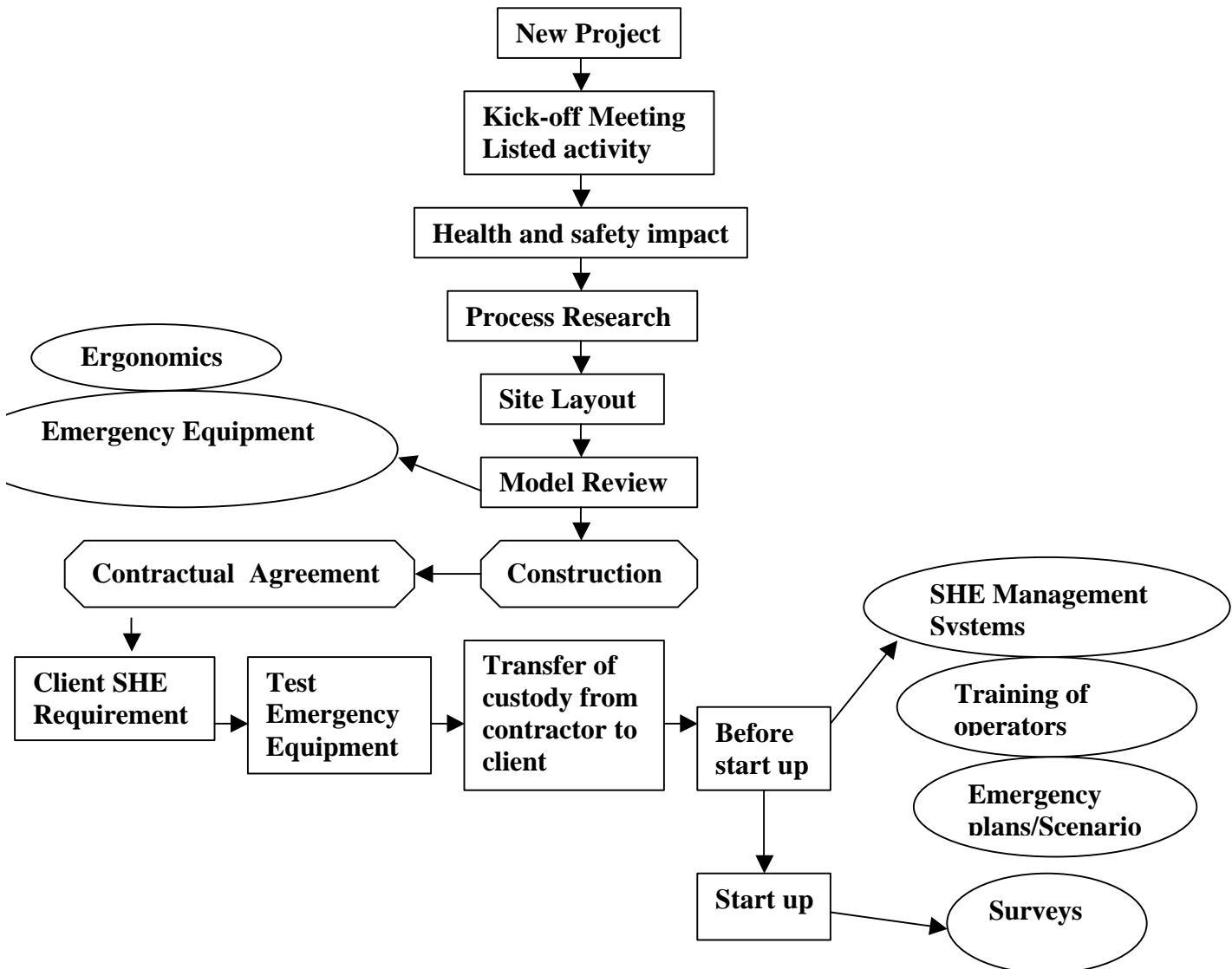
- Get the big picture first.
- Interview most knowledgeable person first.
- Put the person at ease.
- Interview on the spot.
- Interviews should be private.
- Get the individuals version.
- Ask the necessary questions at the right time.
- Repeat the story once you have heard it.
- End each interview on a positive note.
- Record critical information quickly.
- Drawings and photos help.
- Keep the pipeline of communication open.

We had the opportunity during the training to carry out an investigation on a true life accident that had happened few years ago. Our conclusion and steps were properly coordinated by the course facilitator with strong learning points derived at the end of the 2 day exercise.

Other

On a general note, Sasol has a business development and implementation (BD&I) model that puts gates to reduce uncertainties by placing a check on projects. It addresses the concept and viability of a project and determines if it is a worthwhile venture or investment. This is applied effectively along health, safety and environmental standard in all projects undertaken.

Below is a summarised sketch of the process.



This has been applied in the new field of natural gas exploration in Mozambique.

The essence is to be a responsible corporate citizen with best practice and continuous improvement drive in execution of projects thereby reducing risk to as low as reasonably practicable.

### Application of Training.

As a HSE trainer, I've already started sharing my experience in my various training projects for Staff and Contractors of Shell Nigeria apart from disseminating knowledge gained to my dynamic team of HSE trainers in Shell Nigeria( A sort of train the trainers exercise). This is no doubt a significant step, since this trainers are involved in a large number of training and co-ordination of other HSE activities in high risk production outfits of Shell Nigeria. I have also initiated contact with Shell Nigeria corporate HSE accident investigation team who are eager to get me involved in accident investigations and also tap from the Top Set accident investigation tool which is different from the Tripod beta analysis used by the Company.

At Benue cement company where I worked for about 6 years and very familiar with the operational style and activities, I hope to work closely with the chief executive officer on issues of safety and environmental pollution by offering ideas and training key staff at no cost as my contribution to their Safety, Health and Environmental protection project. This company is the biggest Industrial project in Benue state, Nigeria.

Few years ago I initiated a plan to reach out to the Benue State Government on Safety and Environmental issues which I hope to carry out as a result of more insights gained from the IUPAC-UNESCO-UNIDO Safety training in South Africa. There is an adage that says Charity begins at home , I hope to use my influence as an indigene of Benue State and sow Safety and Environmental seeds of best practice which I believe will germinate and spread across the Country. If I can get the State Government, it will create the stepping stone I need to get across to the Federal Government . This I plan to do by e-mail, phone contacts, seminars to the House of Assembly members and visits during my leave or off day periods making use of my few contacts in Government.

I believe safety and Environmental protection is not a cocoon, everybody must make a contribution to make it work. However, the drive to accomplish great things must have a beginning point. To this vision, I desire to nurture and see it grow in leaps and bounds.

See Figure 1 indicating the training carried out by my team in the first quota of the year.

#### KEY:

SPDC----Shell Petroleum Development Company Staff.

Stakeholders---Operating Host Communities, Schools etc.

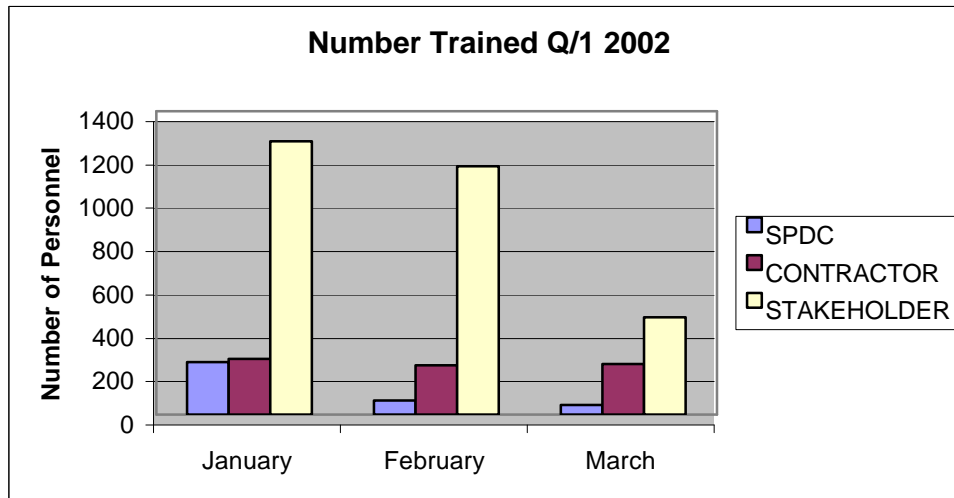
Contractors----Involved in execution of several Shell Projects e.g Drilling of wells.

A similar target is planned for the second half of the year and much of the experience acquired as a result of this exposure will be shared.

I will also use my experience as I carry out SHE audits and Project supervision in the Company to insist on Best practices without compromise at all levels.

<b>MONTH</b>	<b>SPDC</b>	<b>CONTRACTOR</b>	<b>STAKEHOLDER</b>	<b>TOTAL</b>
January	241	257	1262	1760
February	64	227	1147	1438
March	45	232	450	727
<b>TOTAL</b>	<b>350</b>	<b>716</b>	<b>2859</b>	<b>3925</b>

Figure 1



Comments.

This training is a useful tool for scientist in the developing World and I hope that IUPAC-UNESCO-UNIDO will make a follow up on this investment by maintaining contacts with trainees and using them where necessary to fill gaps in future projects apart from regular updating of the knowledge of trainees.

I also wish to suggest that an IUPAC official or delegated representative from the Host Countries Chemical association be available at the first day of the training to welcome trainees and give details of what is expected, this will create a deeper impression on trainees and even the Host Company and also guarantee a more uniform approach in this exercise all over the world.

## Conclusion.

The training is a worthwhile investment and has sensitised me to greater commitment to Safety and Environmental issues. An exposure that has left an impression on me that it is possible to have an indigenous Company in the developing world operate within acceptable and best practices as it's expected in the Industry.

Someone once said "there is a way that seems right to a man but the end, thereof is destruction." It is clear that we cannot just do "what seems right" in our own eyes but indeed use integrated operational standards to do the right thing to guarantee SHE standards in all it's ramifications.

I am grateful to the Almighty God for granting me a safe and Successful trip. My special thanks to IUPAC-UNESCO-UNIDO for giving this opportunity and I'm particularly thankful to Dr. Mark Cesa who was the link man and answered all questions in connection with this training.

Also thanks to CAIA, Sasol of South Africa for providing the platform for the training. My specific thanks to Mr At Nell of R & D, Sasol who co-ordinated my training program and made the experience worthwhile and interesting.

I am also grateful to my Supervisors in Shell Nigeria for allowing me to participate in this program and particularly Mr Martin Castle, Head of HSE Systems, Shell Nigeria for writing a recommendation letter on my Candidature to IUPAC-UNESCO-UNIDO.

I must not forget to thank my dear wife Grace Mngohol for supporting my interest in this program and also keeping the family in good shape while I was away. And to others that I may not have mentioned specifically who contributed to make this a successful outing, I say you have done noble and I know your joy is in my ability to apply the knowledge and exposure to bring about best practice in Safety, Health and Environment in my place of Work and Nigeria as a whole. To this I commit myself as long as there is breath in me.