The Report of the ICFTU-ICEF Mission to study the causes and Effects of the Methyl Isocyanate Gas Leak at the Union Carbide Pesticide Plant in Bhopal, India, on December 2-3-1984

International Confederation of Free Trade Unions International Federation of Chemical, Energy, and General Workers Unions.

This report, based over an onsite study by a 12 member Fact finding committee, is the most accurate and detailed analysis we are likely to have of what happened in Union Carbide's Bhopal Plant and how it came about.

It establishes that while some wrong decisions were made by local plant management, Union Carbide Corp. also bears a major share of responsibility for the catastrophe.

As for the lesson to be learned here at home, none of the conditions which led to the disaster would have been violations of specific standards or regulations of the occupational Safety and Health Administration or the Environmental Protection Agency

On an International basis, the ratification and implementation by many governments and employers of International Labour Organization (ILO) conventions on occupational safety and health could prevent such horrible accidents.

Lane Kirkland
President, AFL-CIO

INTRODUCTION

The Purpose of this report is to Prevent Future Bhopals.

Many People in the developed countries have viewed the Bhopal Tragedy as an isolated event in a far away land that resulted from conditions and factors endemic to developing countries. Statements have been made by governments and the chemical industry that such as accident could not occur in the industrialized western countries. Some have even suggested that accidents like Bhopal are to be expected in developing countries and are the price that must be paid for technological development.

The investigation by our mission does not support these views.

Our investigation revealed, and our report outlines the fact that none of the factors that caused or contributed to the Bhopal accident were unique to the Union Carbide Plant in Bhopal, India Indeed the causes we identified are common to many chemical manufacturing and other industrial Processes through out the world. These conditions were not the inevitable result of technological Progress. But discrete and well-recognized Problems that could have been controlled.

The Mission consisted of :

Pekka O.Aro , Mission leader, Deputy Secretary General ,ICEF

Johan-Ludvik Carlsen, mission secretary, ICFTU

Annie Rice, Occupational Health and Safety Officers , ICEF

Margaret Seminario , Associate Director, Department of Occupational Health and Safety, AFLCIO, U.S.A.

Michael J. Wright , Director of occupational Health and Safety, United Steelworkers of America, U.S.A.

Stephen McClelland, Assistant to the Secretary General, Trade Union Advisory Committee (TUAC) to the organization for economic cooperation and development (OECD)

Jacky Vidal, members of the chemical industry federation of the french Confederation of Democratic Trade unions (CFDT-FUC), and employee of La Littorale, UCC Plant at Beziers , France.

Raja Kulkarni , President, Indian National Chemical Workers' Federation(INTUC)

R.K. Yadav, General Secretary, Union Carbide Karmachari sangh (Nominated to the mission by HMS)

T.D.Singh, Secretary, Madhya Pradesh HMS

N.Nagarajan ICFTU Asian and Pacific Regional Organisation(APRO)

In Delhi, the mission was joined by its indian members on march 31,1985. We visited the offices of both ICFTU affiliates in india ,namely the indian National Trade union Congress (INTUC) and Hindi Mazdoor Sangh(HMS). where we met Mr.Gopeshwar and Mr.Toofan,Respectivly.
We also had audiences with the minister of the Labour. Mr.. T. Anjaiah and the minister of Petroleum. Mr. Nawal Kishore Sharma .We also had meetings with several trade unionists, Government authorities. representative of research institutes and the Press.

In Bhopal , we met the present Chief Minister of the state of Madhya Pradesh , Mr.Vora and the Director of Health Services of the State of Madhya Pradesh ,
Dr. Nagu. we also met several representatives of the two trade unions, Which representatives of the Union Carbide Indian LTD.(UCIL) Bhopal Pesticides Plant, as well as representatives of Health institutions and community groups.

The Trade unions of the chemical workers have for years raised issues Pertaining to the Safety conditions of this industry. None of the issue involved is new or unknown. There are ways of Preventing accidents or contributed to it.. We discuss the implications of the issues arising from accident and its aftermath.

At the end of this report we make recommendation to governments .Chemical Industry companies. International Organization like the ILO and the WHO and the trade unions for measures to improve the safety of workers and the environment.

Bhopal and Some other recent accidents have created a new level of awareness
about hazardous substances and the Potential danger they Present Several developments are taking place to increase information on these questions and to diminish the risks. As an appendix you will find a resolution which was presented by our member's and adopted by the ILO's annual conference in June , The international free trade union movements is committed to do its part. We hope this document contributes to the formulation of that policy.

A very important aspect which needs urgent consideration is the fate of the former workers of the Bhopal Plant. The plant has been shut down since the accident. The company has announced that it will not be opened again .At the moment, there are very few concrete measures being taken to restore employment to these people .The ongoing trials have to do with the gas victims, not with the people who lost their jobs. The international trade union movements has

to support the effects of the Indian union's to combat this problem.

At the moment of the writing there are various investigations taking place. The most important one is a one man inquiry commission appointed by the state government of Madhya Pradesh . It will take at least months to be completed and the union's will watch closely the deliberation and the outcome. Among other things, it is a test of the integrity of the Indian authorities.

CONCLUSIONS

In compiling this report, the mission relied on several sources of Information . Including news accounts from Indian, European and American publications; articles from technical journals; Union Carbide technical manuals and reports ; documents compiled by the U.S. Congress ; materials Published by Indian Community and scientific organization : and Correspondence between the unions representing Bhopal workers, The Company , and the government. In addition, the delegation interviewed more then thirty Union Carbide Worker, Including Several who were on duty on the night of the release, as well as leader of the local and national Union's . Victims of the disaster, medical personnel, present and former government officials and community activists working on behalf of are sometimes contradictory .A clearer picture emerges from the Union Carbide Workers. Based on the Information available to us , the mission has reached the following conclusion about the causes of the Bhopal tragedy;

The disaster was caused by insufficient attention to safety in the process design, dangerous operating Procedures, Lack of Proper maintenance, faulty equipment, and deep cuts in manning levels, crew sizes, worker training and skilled supervision, Smaller releases of toxic , and skilled supervision. Smaller releases of toxic chemicals had occurred in the past., Leading to one death and numerous injuries . Little was done to correct these Problems. despite vigorous protests by the Union representing Bhopal Workers.

The accident was Probably triggered by a runaway reaction occurring when water entered methyl Isocyanate (MIC) storage tank . A likely Source of the water was a faulty maintenance Procedure on the evening of December 2, 1984.

The operating and maintenance errors which led to the MIC release were made by management of the Bhopal plant and Union Carbide India limited (UCIL). However, responsibility for the disaster also rests with UCIL' S parent multinational, the U.S-based Union Carbide Corporation (UCC).UCC insisted on a process design requiring, large MIC storage tanks, over the objections of UCIL , engineers, in addition , a 1982 corporate inspection report demonstrates that UCC knew the Bhopal plant had major safety Problems. But the company did not take sufficient action to correct them.

The government of Indian and the state of Madhya Pradesh did not cause, and are not directly responsible for. the gas release .However , stronger worker safety and environment regulations , and stricter enforcement . Could have prevented it.

Chemical accidents are rarely identical , and it is unlikely that an equivalent accident involving MIC will happen again in the limited number of plants still using it. However , the process design , equipment , operating , maintenance , manning , training , and supervisory Problems that caused the Bhopal disaster are not unique to Union Carbide , India , or developing countries. Highly dangerous chemicals are produced , used , stored transported and spilled - throughout the world . Bhopal was not the first chemical disaster . In the absence of strong national and international regulations. rigorously enforced , the next such tragedy is only a matter of time.

UNION CARBIDE IN BHOPAL

Union Carbide has a long history in India, beginning in 1905 when the company began selling products manufactured elsewhere. In 1924, a plant was opened in Calcutta to assemble battery components made in Britain. By 1983, Union Carbide was operating 14 Indian plants manufacturing pesticides, chemicals batteries, industrial carbon, and other products.

Union Carbide's Indian interests are held by Union Carbide India interests are held by Union Carbide India Limited, Which is 50.9% owned by the parent multinational, and 49.1% by Indian investors. India's 1973 Foreign Exchange Regulation Act generally limits foreign investors to minority ownership, but UCC persuaded the Indian government to waive the requirement in its case, on the basis of the technological sophistication of its plants, and the offsetting factor of exports. UCC exercise managerial control through its Eastern Division headquarters in Hong Kong. Bhopal workers and national union officials maintain that even minor production and maintenance decision were made by Hong Kong.

The Bhopal plant opened in 1969. At First . UCIL Bhopal only formulated carbamate pesticides from concentrates imported from U.S. , but in 1975 UCIL was licensed by the Indian government to produce its own carbary1 (trade name"sevin") Methyl isocyanate (MIC) is a chemical intermediate in the sevin manufacturing process chosen by UCC. For a time, the Bhopal plant depended on MIC imported from Union Carbide's plant in Institute , West Virginia . However, UCIL added an MIC production unit to the Bhopal plant in 1979. The unit was approved and designed by UCC in the United States.

The licensed registered capacity of the plant was 5,250 tonnes in 1983, falling to 1,657 tonnes in 1983. The decline was Primarily due to mistaken market estimates, exacerbated by growing impact of competing pesticides like synthetic pyrethroids as a result, the plant was losing money, and UCIL- with UCC' s permission- may well have been looking for a buyer.

The Carbaryl process in use in Bhopal began with chlorine, brought in by tank truck, and carbon monoxide, produced on site from coke, which were reacted to from phosgene, which was used as a lethal gas in world war I killed one Bhopal worker in a 1981 accident. Purified Phosgene was sent to a reactor Vessel and pyrolysis unit to combine with monomethylamine , ultimately forming MIC. Chloroform was used as a solvent in this process. The Bhopal plant stored refined MIC until needed in two underground 15,000 gallon tanks , designated 610 and 611 . A third tank, 619 . was available as a backup . Eventually, the MIC was reacted with alpha -naphtol to from sevin.

THE ACCIDENT

The Bhopal plaint's MIC production unit was shut down for maintenance and to reduce inventories in mid -October 1984, with more then 185,000 Ibs. (23, 125 gal.) of MIC stored in the underground tanks. Some of the MIC in the second storage tank, tank 611, was converted to Carbaryl after November 24, Ordinarily, the MIC in tank 610 Would have been used first, but the operators had been unable to pressurize the tank with nitrogen, which is used to transfer MIC to the Sevin unit . As a result, tank 610 contained more than 11,290 gal, of MIC on the night of December 2.

MIC is highly reactive, unstable, flammable, volatile, and toxic. It reacts with acids, alkalies , water, and a variety of organic chemicals. It can even react with itself. Most of these reactions are exothermic (they give off heat); some are violent . The flash point of MIC is -18 c, and a concentration of only 6% in air is explosive . MIC boils at 39.1 C. The threshold limit value set by the American conference of Government Industrial Hygienist is 0.02 ppm. among the lowest for any substance. Union Carbide's material safety data sheet states: "Methyl isocyanate can undergo a 'run-away' reaction if contaminated. A vapor cloud constitutes from the standpoint of ignition (a 'fire-ball' could result) and toxicity."

Such a chemical deserves respect, and the Bhopal MIC plant contained several safety systems. MIC reacts more

violently when warm, So the storage tanks included refrigeration system. The tanks were protected from overpressure by safety valves and rupture disks . The system was designed to vent escaping gases to a vent gas scrubber, to be neutralized with caustic soda, and then to a flare tower.

The events of December 2-3, 1984 have been described by a number of publication, and by Union Carbide in its ."Bhopal Methyl Isocyanate incident Investigation Team Report," published on March 20, 1985. Our primary sources were the workers them-selves . The most complete journalistic account, and the one that most closely agrees with the workers, was written by Bhart Bhushan and Arun Subramaniam for the February 25 issue of business India(see Diagrams 1 and 2).

Unfortunately, the mission was not permitted to enter the plant, due to an ongoing investigation by the Indian central Bureau of investigation . While we had access to the 1978 Union Carbide Bhopal MIC unit operating Manual, along with the piping, process, and control diagrams because they were made after the plant began operating. As a result, we were unable to check important technical of the accident will have to await more complete information..

The Union Carbide report states that the reaction in the tank 610 which released the gas was triggered by 1000 -2000 IBS . of water (120-240 gallons)entering the tank. UCC claims not to know the source of water, and goes so far as to speculate that it may have been introduced deliberately. During the press conference UCC held when it released the report, Ronald van Mynen . UCC'S corporate safety and health director, hypothesized that the water may have come from a nearby utility station which supplied water and nitrogen to the area: "If someone had connected a tubing to the water line instead of the nitrogen line, either deliberately or intending to introduce nitrogen into the tank, this could account for the presence of the water....."

The Workers disputed this account, insisting that no such connection was made on the night of December 2. During the press conference, Van Myna's admitted that the company's investigation team found no evidence for a connection. Nor is it clear why someone would wish to hook up a nitrogen can easily be introduced into the tank through permanent fixed lines. Although Van Myna' s hypothesis in our view is unlikely, the company's admission that such a mistake is even possible is in an example of unsafe plant design . Given the lethal natural of the water MIC reaction, UCC should have used incompatible fitting on the water and nitrogen system to prevent their interconnection.

The Bhopal worker we interviewed Provided an explanation of the water in tank 610 which is, in our view, much more Credible and consistent with what is known about the plant. Their account follows:

Sometime on December 2, the production superintendent ordered the MIC plant supervisors to flush out several lines leading from the phosgene area to the vent gas scrubber, This operation involves connecting a water line, closing an upstream isolation valves. The work was begun at about 9:30 p.m. on the second shift. Ordinarily, the lines are isolated by a slip blind (a physical barrier, inserted into a pipe or fitting, which prevents material from passing). Line washing is the duty of an MIC operator, while installing the slip blind is the responsibility of maintenance , However, according to the workers, the second shift maintenance supervisor position had been eliminated several days earlier, and no workers was told to insert the slip blind. The operator could not see the slip blind holder from his location, and had no way of way of knowing that it was not present and in place.

Unfortunately, the downstream bleeder lines were partially clogged, So water began to Accumulate in the pipes. Many of the valves in the plant were leaking, including the isolation valve, So water rose past the valve into the relief valve vent header, a line connecting various pieces of equipment to the pressure relief system. When the operator noticed that no water was coming out of the bleeder lines, he shut off the flow, but the MIC plant supervisor ordered him to resume.

The relief value vent header is about 20 feet(7 meters) off the ground at its highest point. From it, the water flowed downhill into the tank through a series of valves. The first two are part of a jumper line between the relief valve vent header and the process line for the three tanks. The jumper is not shown on the diagram Published by UCC in its March 20 report, but the described it in our interviews . The workers stated that, since the jumper constituted a design change, standard procedures would have dictated its approval by UCC in Hong Kong or the USA.

Part of the process vent header was being repaired at the time of the accident, So the valves at each end of the jumper were open. As a result, water flowed from the relief value vent header. From there, the water flowed to the main isolation valve for the process vent header, which is normally open, to a diaphragm motor valve which should have been closed. However , that values is part of the system used to pressurize the tank with nitrogen, and since the tank could not be presurized in the days preceding the accident . the valve may will have been faulty . It is also possible that the valve, was inadvertently left open, or had not seated properly, since the valve, was routinely opened and motor valve, the water flowed down, past the main tank isolation valve, which was almost always kept open, into the tank itself.

Eventually, the clogged bleeders were freed and water stopped entering the process vent header . By that time, the water in the tank 610 had begun to react with the MIC. The reaction was slow at first, but when the third shift reported for work at 10:45 p.m., they began to suffer throat and eye irritation from an Mic leak close to the area where the lines were being washed. The exact source of the small leak was never determined, since the worker were soon overwhelmed by the much larger MIC release, but the MIC was probably escaping back along the same route by which the water previously had entered.

From the Point on, the UCC report and the worker's account agree. At 11:00 p.m., the control room operator noted that the pressure in tank 610 had risen from 2 to 10 psig. The MIC water reaction proceeds much more rapidly if it is catalyzed by iron. UCC'S march 20 report theorizes that the MIC in tank 610 was contaminated by chloroform, which begun to release chloride ions as the heat and the pressure in the tank increased. Others have speculated that the chloride came from phosgence, which also could have contaminated the MIC. What ever its source, the chloride came attacked the walls of the tank, ieeching out iron. Catalyzed, the reaction's intensity increased rapidly. Creating still more heat and pressure, releasing still more chloride and more iron, intensifying the reaction still more. At 12:15 a.m. the operator checked the tank pressure again. It was 30 psig and rising rapidly. Seconds later, the reading was off scales. The rupture disk/safety valve system is designed to give way at 40 psig, and when it did, the contents of tank 610 rushed through the lines at a least 720 ibs per minute.At the height of the reaction, the pressure in the the tank was probably above 200 psig, and the temperature above 200 C.

The escaping gas went first to the vent gas scrubber. It is not yet clear whether the scrubber functioned on the night of the release. The pump had been shut off, and the instrument panel in the control room indicated that they could not be restarted panel in the control room indicated that they could not be restarted. On the other hand, the caustic soda in the scrubber was found to be hot the next morning, indicating that some reaction had taken place. In any event, from the information published in the Bhopal operating manual and press reports after the accident, it appears that the scrubber did not have the capacity to handle the massive release.

From the scrubber, the gas should have gone to the flare tower, but the unit was out of service. The pipe leading to it had been removed for maintenance pipe leading to it had been removed for maintenance weeks earlier. So the gas was vented directly to the atmosphere. Several workers made a last ditch effort to spray the escaping gas with water to neutralize it. Wearing full face respirators and rapidly running out of air, they struggled with poorly maintained valves to turn on the water spray, only to find that the pressure was not sufficient to reach the gas . One worker kept trying even after he had run out of air. choking from the gas, he finally tried to escape over the wall, but passed out, falling to the ground where he was rescued by other's. One supervisor tried to climb the MIC structure to plug the gas leak, although that would have been stooped. By 1:00 a.m. on December 3, a lethal cloud was drifting

over the unsuspecting neighborhoods of Bhopal, where it would kill at least 2,500 people and injure more than 200,000.

CAUSES OF THE RELEASE

MIC Storage

Large volumes of MIC were stored in the Bhopal plant. Reports on the volume of MIC in tank 610 at the time of the accident vary from 11,290 gallons(75% capacity) to 13,000 gallons (87% capacity). The low figure is contained in the Union Carbide report, which figure is contained to the Union carbide report, Which also maintains that such a volume is "well below the maximum operating level." However , union carbide's technical manual on MIC suggests a limit of 50%. Bhopal workers confirmed that all there MIC storage tanks were frequently filled above the recommended level.

According to calculations based on data in the Union carbide report, tank 611 contained 11,565 gallons of MIC until November 24, after which it was slowly drawn down for production to 5,620 gallons on the night of the accident . Tank 619 also contained a small amount of contaminated MIC, despite the fact that Union carbide's 1978 Bhopal MIC unit operating manual states that one tank is always to be kept empty in case of emergencies.

This long-term storage of large amounts of MIC was a direct causes of the accident . The accident would not have occurred if the MIC in tank 610 and 611 had been promptly converted to sevin after the MIC unit was shut down. If either tank 611 and 619 had been empty, it could have been used as a surge tank to contain some of the reacting MIC on the night of the accident , thus giving operators more time to regain control of the reaction. In fact, operators wee not even sure how much MIC was in tanks 611 and 619, since many of the gauges in the plant were unreliable and not trusted by the workers. As a result, workers where afraid to open the line to tanks 611 and 619. Since they did not know the causes of the reaction in the tank 610, they feared spreading the problems to the adjacent tanks.

Indeed, it was never necessary to store more than minor amounts of MIC in Bhopal . when the plant was first designed , Edward A. Munoz, the managing director of Union carbide Ltd,. took the position that large volume storage of MIC was contrary to safety and economic considerations . In a sworn affidavit to the Judicial Panel on Multidistrict Litigation considering of the Bhopal case , Mr. Munoz said that he had recommended , on behalf of UCIL, that the preliminary design of the Bhopal MIC facility be altered to involve only token storage in small individual containers, instead of large bilk storage tanks, However , UCIL was overruled by the parent corporation , which insisted on a design similar to UCC institute, west Virginia plant. Other UCC facilities which use MIC(but do not produce it) store the chemical in small containers. Such storage is considered safer, owing to much smaller quantity in each container.

In fact, Union carbide could have produced Sevin in Bhopal without any MIC storage. Since MIC is a chemical intermediate, the process could have been designed in a such a way that MIC was consumed immediately after it was produced. DuPont is currently building such a plant in Laporte, Texas. Dupont has stated that no more then 20 pound of MIC will be in the system at any one time. A similar process is currently used by Mitsubishi in Japan.

It should also be noted that Carbaryl, the pesticide produced at Bhopal under the trade name sevin, can be made without MIC. Although that process, like the chemical, UCC may have chosen the MIC process on economic grounds. MIC is a chemical intermediate for a number of pesticides, and before the accident Union Carbide's institute plant sold large amounts of it to other companies. UCC probably had similar plans for the Bhopal plant when it was designed.

Safety Systems

The Bhopal plant had four major safety systems designed to prevent or neutralize an uncontrolled MIC reaction:
A 30 ton refrigeration unit to cool stored MIC, in order to prevent it from vaporizing or reacting;
A vent gas scrubber (VGS) to neutralize toxic gases with caustic soda in the event of a release;
A flare tower to burn vented gases from the MIC storage tanks and other equipment; and
A water spray system to knock down escaping vapors.

At the time of the accident, according to the workers, three of these systems were not operating.

The 30ton refrigeration unit had been shut down since June 1984. There were no mechanical problems with the system; it was taken out of service to save money The Freon refrigerant had been drained out for use elsewhere in the plant . The shutdown was in violation of established operating procedures.

The vent gas scrubber (VGS) was turned off in October, 1984, apparently because the supervisors thought it was not necessary when MIC was only being stored and not produced . In addition, the caustic flow indicator was malfunctioning, so it would have been difficult to verify whether the unit was operating or not.

The flare had also been out of service since mid-October. A section of corroded pipe leading to it had been removed even though replacement pipe was not ready. The workers stated that the replacement pipe could have been prepared in the plant, and should have taken only four hours to install. However, as of December 2, the pipe had not been replaced, and the escaping gas could not be directed to the tower. In addition, the company had compromised the reliability of the flare tower even before it was disconnected. The tower was originally built with a backup set to fuel gas cylinders to ensure that the pilot light stayed on. However, the backup system was discontinued to save money.

In spite of all of this, even if the systems had been operating, it does not appear that they could have contained the massive realease of MIC gas.

There is some controversy over whether the vent gas scrubber operated at the time of the accident . But if the figures released by Union Carbide are correct, the gas escaped at rate of 400-800 Ibs/ minute , at a pressure and temperature approaching 200 psig and 200 C. Union Carbide's 1978 Bhopal operating Manual gives the "maximum allowable working pressure" of the VGS as 15 psig at 120 C, and the nominal feed rate" as 3.2 Ibs/minute. Indeed the manual lists "high pressure in the vent scrubber" as a process "upset ," for which the remedy is check for the source of release and rectify."Similarly, "toxic gas release to the atmosphere "from the VGS is also considered as "upset," Caused by "high release of the toxic streams from the process," for which the remedy is "check the source of the release and normalize." In short, the VGs was never dasigned to handle the kind of release which occurred reduced the severity of the accident, even if it had operated.

The MIC unit operating manual does not contain the details of the flare tower, and it is unclear whether it was capable of safety flaring MIC at the rate it was being release However, some workers believe that had the falre tower been put into operation during the release, the enormous MIC cloud near the tower would have exploded, destroying piping systems in the plant and releasing even more MIC.

According to worker interviewed , the water spray shroud which was activated the night of the accident did not reach the level of the gas release, and was therefore useless . In 1982, Union Carbide Corporation, after inspecting the Bhopal facility, had recommended a new, larger water spray system, but it was never installed.

Maintenance

Inadequate maintenance was a longstanding complaint at the Bhopal plant. The poor maintenance of the major safety systems has already been described. These problems extended to production equipment.

According to the workers, leaking valves and malfunctioning gauges were common throughout the facility . A 1982 Union Carbide Corporation inspection of the plant by U.S. safety personnel noted such problems, and resulted in the replacement of valves in the MIC unit; but at the time of the accident, valves and pipes had again corroded and leaking valves were a serious problem. Leaking valves probably allowed water to enter the tank. Broken gauges made it hard for MIC operators to understand what was happening. In particular, the pressure indicator/ control, temperature indicator and the level indicator for the MIC storage tanks had been malfunctioning for more than a year.

Manning

At the time of the accident, the Bhopal plant, including the MIC facility, was operating with reduced manpower. According to the workers and published reports, the plant had been losing money, and in 1983 and 1984 there were more personnel reductions in order to cut costs. Some worker were laid off. and 150 permanent worker were pooled and assigned to jobs as needed. The workers we interviewed said that employees were often assigned to jobs they were not qualified to do. This practice was also noted by Union Carbide corporation in its 1982 inspection report. If the workers refused to do the job which they were assigned on grounds they were not trained, their salaries were reduced.

In the MIC facility the production crew had been cut from 12(11 operators, 1 supervisor) to 6(5 operators.1 supervisor), and the maintenance crew reduced from 6 to 2. According to the workers, the maintenance supervisor position on the second and third shifts had been cut on November 26, less than a week before accident. The maintenance work and giving instructions for the job. The workers indicated that it would have been the responsibility of the maintenance supervisor to prepare the pipe which was being flushed with water the night of December 2, 1984, including to prevent the entry of water into the pipes leading to tank 610.

When the post of maintenance supervisor was eliminated , these responsibilities apparently shifted to the production supervisor. But according to the workers, the production supervisor on duty the night of December 2 had been transferred from a Union Carbide Battery plant one month before and was not fully familiar with either operating or maintenance procedures.

Training

Traning was a major problem at the Bhopal plant. At the time the MIC facility was opened in 1980, 25 people were sent to the United States for training. But due to high turnover---- 80% in the MIC plant from 1982-1984 by the workers estimate -----few of the people originally trained in the MIC operation in the U.S. remained in Bhopal

The worker said that they had been given little or no training about the safety and health hazards of MIC or other toxic substances in the plant; they thought the worst effect of MIC was irritation of the eyes. Even a maintenance worker who had been assigned to the MIC facility since it first began operation in 1980, stated that he had been given virually no training about the safety and health hazards of MIC.

Language also may have contributed to the lack of understanding about MIC and other hazards . All sings and operating Procedures were written in English. even though maany of the workers spoke only Hindi. Workers stated that if wrote in the log books in Hindi, they were reprimanded.

Insufficient Corporate Attention to Safety

In May of 1982, a three man team from Union Carbide corporation in the USA inspected the Bhopal plant. In its report, the team found a number of "Concerns" which they classified as "Major" or "less serious ." with major concerns being those that represented " either a higher potential for a serious incident or more serious consequences if an incident should occur."

The team listed 10 major concerns. Among them were;

3. Potentials for release of toxic materials in the phosgene /MIC unit and storage areas, either due to equipment failure, operating problems, or maintenance problems.

4. Lack of fixed water spray protection in several areas of the plant.

7. Deficiences in safety valve and instrument maintence program.

8. Deficiences in Master Tag/ Lockout procedure application.

10. Problems created by high personnnel turnover at the plant, particularly in operations.

Problems like these led to the catastrophic MIC release 2-1/2 years later. But while the team classified these items as "major" in relation to the other "less serious " concerns, the overall message UCC sent its Indian subsidiary was at best confusing . The report's opening summary States:

The team was very favorably impressed with the number and quality of operating and maintenance procedures that had been developed and implement in the past 1-2 years . These procedures together with the job safety Analyses detailed for most operations, constitute a major step for all concerned...No situation involving imminent danger or requiring immediate correction were during the course of the servey.

In accord with corporate procedures, UCIL prepared an action plan in response to the 1982 inspection and sent periodic progress reports to the United states until June 1984. But UCC never sent a follow -up team to Bhopal in the two -and- half years between the inspection and the accident. The workers report that UCIL did temporarily fix many of the items cited in the 1982 report, but by the time of the accident, conditions had again deteriorated.

Labor Relations and Management Disputes

The Bhopal plant was plagued by labor relations problems and internal management disputes. In India there can be more than one union representing workers as a plant. At Union Carbide Bhopal there had been conflicts between a union affiliated with the Indian National trades union congress (INTUC) and an independent union over who represented the majority of workers in the plant. Even at the moment of this writing there is a court case pending on representation rights . According to workers management tried to use this interunion rivalry to its advantage in contract negotiations to reduce manning levels and in other labor relations matters.

It also appears that there were internal management disputes in the company .The management structure of UCIL changed before the accident, and the Bhopal Pesticides plant was put under the direction of the Union Carbide battery division in India. According to the workers, this resulted in management conflicts within UCIL and the transfer of managers to Bhopal from the battery division in India. According to the workers, this resulted in management conflicts within UCIL and transfer of managers to Bhopal from the battery operation who were not

fully trained about the hazards and appropriate operating procedures for the pesticides plant.

Failure to Respond to Pervious Accident and workers warnings

The December 2-3 1984, MIC release was not the first accident at the Bhopal plant. Published reports and interviews with worker we spoke with indicate that there were at least five chemical accident in the plant between 1981 and 1984.

In December 1981 a phosgene leak injured three workers; one of the workers died the next day. Two weeks later in January 1982, 24 workers were overcome by another phosgene leak. In February 1982 an MIC leak affected 18 people. IN August 1982 a chemical engineer came into contact with liquid MIC resulting in burns over 30% of his body . And in October 1982 a combined MIC, hydrochloric acid and chloroform leak injured three workers in the plant and affected a number of residents of the surrounding neighborhoods.

Since 1976 the two unions representing Bhopal workers had frequently complained to Union Carbide management and the Madhya Pradesh authorities, including the Factory Inspectorate, about safety and health hazards in the plant. Correspondence obtained from the local INTUC affiliated union, and our interviews in Bhopal, demonstrate that both Unions consistently raised health and safety issues with management and the government, and warned of grave dangers if the conditions were not corrected.

In a July 1976 letter to the General Manager of the Bhopal plant, the Union listed five serious accidents, including one case of chemical burns and one of blindness resulting from separate incidents. The letter stated:

On reviewing the above incidents one can conclude that the safety measures aare inadequate. Despite the instructions from the government before commencement of production that the worker safety should be given top priority, we fee that you have neglected this aspect.

In an April 13, 1982, letter to the Minister of Labour or Madhya Pradesh, the union wrote:

Our unit is going to celebrate the safety week from the 14th of April, 1982. But the workers would like to inform you that this function is merely a window-display..... we would also like point out that our unit is manufacturing dangerous chemicals like phosgene , carbon monoxide, methyl iscocyanate , BHC, naphtha and temik.

After the October 1982 combined release of MIC.hydrochloric acid and chloroform. Which spread into the community, the union printed hundreds of posters (in Hindi) which they distributed throughout the community, warning:

Beware of Fatal Accidents

Lives of thousands of workers and citizens in danger because of poisonous gas

Spurt of accidents in the factory, safey measures deficient.

But despite these constant warnings by the union, little was done to correct these problems and prevent a potential disaster.

CONTRIBUTING FACTORS

In addition to the direct causes described above, several other factors indirectly contributed to the accident and increased its severity . These include the following.

Failure to Inform workers and the public

The Bhopal plant produced, used stored and transported a number of toxic and hazardous pesticides, feedstocks and chemical intermediates that posed a risk to UCIL workers and the public. However, UCIL never provided complete information about these chemicals to workers, government authorities, or community residents. Most of the workers we spoke with said they had received no training or information about the hazards of MIC or other toxic chemicals in the plant. Residents of J. P. Nager and other neighborhoods in Bhopal had little idea what UCIL produced; many residents thought the plant was making "medicine" for crops.

City and state authorities were provided no information on the identites and hazards of the chemicals present in the plant ; none of the officials we spoke with had been told before the accident how MIC was produced or used.

Even after the accident, UCC and UCIL failed to provide adequate information on MIC and its hazards. On December 3rd, as thousands of people lay dead or dying in the streets, the medical director of the Bhopal plant continued to insist that methyl isocyanate was only an irritant and not life threatening. A worker who was overcome by MIC the night of the accident, and went to the UCIL medical dispensary the next morning, was told by the same company doctor not to worry, given a shot of medication and sent home. The workers soon developed delayed pulmonary edema and was rushed to the hospital in critical condition.

Medical authorities stated that they received little if any information on the diagnosis and treatment of MIC injuries from either UCIL or UCC. A hospital, directors told us that he finally found out that the chemical was MIC from a newspaper report on the evening of December 3rd; the state health director finally received solid information on the chemical from the world Health organization several days the accident .Indeed, the first communication from UCC in the U. S. appears to have been a telex received December 5, which briefly outlined possible treatment, but did not fully describe the possible toxic effects of MIC.

Inadequate Action by Government Authorities

In India , work place safety and healthy conditions are governed by the 1948 Factory Act. While the legislation is federal, inspection of health and safety conditions is the responsibility of state authorities, in this case the state of Madhya pradesh. For the Bhopal are, the state employed two factors. Both inspectors were mechanical engineers with neither the training nor equipment to assess potential hazards posed by chemicals.
However, the factory inspectorate had long been aware of health and safety problems in the Bhopal plant. Union leaders had frequently complained to authorities about safety problems in the plant and the risk of a major gas release. The state factory inspectorate had conducted inspections following the fatal gas leak in 1981 and a subsequent leak a 1982. According to union officials and workers no action was taken by the government authorities did nit causes the Bhopal accident, it is clear that they failed to take the necessary action that could have prevented the accident from occurring.

Plant Siting

The Bhopal plant was located in a heavily populated area. Some of the residential growth in the immediate vicinity . Including the establishment of the J.P.Nager shanty town directly across the street, took place after the plant was first opened in 1967. These settlement were not originally authorized, but in 1984 the government gave the squatters ownership rights to the land to avoid forcing them out of their homes.

However, even in the absence of the recent settlements .the plant was built dangerously close to the core of the city and was only a mile(less than two Kilometers) upwind from the Bhopal train station where hundreds of people slept

at the time of the accident. Some of the neighborhoods most effected by the gas had been inhabited for more than 100 years.

The problem was not that people decided to live near the plant. but that the company built the plant near pre-existing residential areas.

The 1975 Bhopal Development plan, a kind of municipal zoning ordinance, specifically called for the siting of obnoxious and hazardous end of the city, Where prevailing winds would disperse releases away from dense population zones. But the plan was ignored in the case of union carbide . If the 1975 plan had been followed, it is likely that the impact of the accident would have been significantly reduced.

Lack of Disaster planning

Union Carbide was aware that the chemicals produced and used in the Bhopal plant posed a risk to workers and the community at large. Leaks of toxic chemicals from the plant had affected both workers and the public. However, a disaster plan for warning and evacuating the community in the event of a leak had never been developed . The plant is reported to have had two sirens, one to warn the public. However, it is not clear when the alarm was sounded, people affected by the gas had no idea what was happening, or to where they should flee.

The emergency plans for workers in the plant were only marginally better. Workers informed us that in the event of a leak they had been instructed to check the wind indicators and run into the wind, away from the directions of the gas dispersion. However, most escape routes from the plant were blocked. The plant is surrounded by an 8 foot(2.5 meters)concrete wall topped with barbed wire; only one gate, workers were forced to scale the wall and squeeze through the barbed wire to escape.

NON CAUSES

We believe there are several factors which can be ruled out as causes of the Bhopal disaster, in particular, the notion of sabotage. After much public criticism, union carbide has backed away from its March 20 suggestion that water was "deliberately" introduced into tank 610. There was never any evidence for such an act, a fact the company now admits.

Others have suggested that the workers were some how responsible, by failing to take proper precautions, or by running away when the leak began. But the major design, operating, and maintenance decisions which led to the release were made by UCC and UCIL management . The line washing procedure which we believe allowed water to enter the tank 610 was ordered by management. The worker ordered to wash the line had no way of knowing that the slip blind was not in place, Since it was not his job to install it, and he could not see it from his location. Of course, Bhopal workers were not responsible for the decision to store large quantities of MIC in Bhopal, or to discontinue refrigerating the MIC tanks, or to disconnect the flare tower.

It is true that some workers ran form the area during the release. That is what they had always been told to de by UCIL management. Since gas leaks had occurred several times in the past, it is not surprising that they feared for their lives. In any event, there is nothing they could have done. The reaction could not have been stopped after the safety valve on tank 610 blew open. But many workers stayed in the plant and tried. Several were injured in the attempt.

Nor can the cause be located in a lack of worker concern for safety. The letter and poster campaigns of the two plant unions, and their frequent complaints to management and the government, have already been described. The unions were as active in pressing health and safety concerns as any other union with which we are familiar in developed or

developing countries.

Some have suggested that India and other developing nations are incapable of handling modern technology, However, chemical disasters similar in cause to the Bhopal tragedy have also occurred in highly developed countries, most notably, the large dioxin release in Seveso, Italy, on July 10, 1976, and the chemical plant explosion in Flixborough, United Kingdom which killed 28 people and injured 89 on June 1, 1974. While we were in Bhopal, the mission visited a large electrical equjipment plant (Bharat Heavy Electrical Limited) owned by the Indian government. Most industrial plants have some safety and health problems, but the ventilation systems and other engineering controls for toxic substances at BHEL Bhopal were at least as good as in similar plants in the United States.

Some have suggested that accidents like the Bhopal tragedy are an inevitable consequence of progress. One commentator even stated that half the people who died in the accident would not have been alive in the first place had it not been for the rise in agricultural productivity resulting from pesticides like the ones produced in the plant. However, faulty design, dangerous operating procedures, lack of proper maintenance and inadequate training are not inevitable or inherent in modern technology.

The Bhopal disaster could have been prevented.

EFFECTS

Given the nature of the gas leaked at Bhopal and considering that a substantial section of the population was also exposed to non-lethal doses, the effects of which could manifest over long periods of time, it is very difficult to arrive at definite estimate of the number of casualties.

The Indian Government estimates that approximately 1,700 people died. Most of the more reliable news accounts put the figure around 2,600. The true number will never be known, because in the chaotic situation during the first days after the accident, bodies were buried and burned without proper identification or even count. But it is likely that both of the above mentioned numbers are too small. There are still thousands of people registered as missing. Another reason why we do not trust there low figures is that the government death toll only includes those bodies registered at the mortuaries.

Dr. Nagu, the Director of Health Services of the state of Madhya Pradesh said that the Bhopal hospitals treated at least 130,000 patients for problems - mainly of the eyes and lungs. In addition, over 40,000 patients were treated in the other 22 districts of the state. These were to a large extent people who fled from Bhopal by whatever means, they had. According to him, 12,000 of the 170,000 patients were in a very critical condition when they were brought to hospitals and wards, 484 of them died, and he estimated the total number of dead at 2,000.

Dr. K.V. Pandya, the chief medical officer of Kasturba Hospital (BHEL) told us that his hospital treated over 15,000 patients, most of them outside on the hospital grounds: 95-98% of the victims also had eye problems. Almost 100% of the victims also had lung problems-pulmonary edema. Vomitting was also a very common complaint.

No official line of treatment was, however, forth-coming mainly because doctors in charge had no idea of the cause of the accident and this in turn because Union Carbide provided practically no medial information to the authorities. In fact, on December 3, the company was still claiming that MIC was not lethal, but that it causes only eye irritation.

Because no information was forthcoming from UCC, initial treatment was essentially supportive-oxygen, bronchodilators, diuretics, corticosteroids to reduce inflammatory conditions. Control of blindness was already well-established in the state so cortisone drops and sulfa drugs were readily available and used to relieve eye problems.

Most of the eye problems subsided.

Lund damage on the other hand was much more serious and lasted longer. The strong irritant effects of MIC caused massive build up of fluid in the lungs (edema) as a result of large scale tissue damage and this probably accounted for the majority of deaths.

Although initial treatment was supported by the WHO representative, Dr. Jaeger, who arrived on December 8, i the midst of the great confusion of the first days there arose a strong dispute between medical experts on the methods of treatment. Autopsies carried out by Dr. Hairach Chandra of the Forensic Medicine Dept, on the morning of December 3 showed that all the classic textbook symptoms of cyanide poisoning were present. These included cherry-red blood, also in the heart and brain, softening of brain tissue and early rigor mortis. His conclusion was that cyanide poisoning was present and that thiosulphate as an antidote was needed for remaining victims.

On December 5, UCC-USA advised from West Virginia on treatment for the victims. They advised the use of, among others, amyl nitrite for cyanide poisoning and, if this did not work, to combine it with injections of sodium thiosulphate. Later, UCC retracted this advice, stating that a misunderstanding had occured, and recommended that such injections should be discontinued.

On December 8 a Munich doctor showed that blood samples of dead victims contained 2 ppm cyanide. Further autopsies confirmed this. He and another doctor then proceeded to give 50 thiosulphate injections. Both thought that those receiving this treatment showed an amelioration of symptoms but this effort was terminated after a dispute with the local health authorities.

The question arises here as to where the cyanide in the blood came from-did the cyanide come from MIC or was cyanide also released in the leak?

Such an amount of cyanide ions in the blood have to come from outside-there is no possibility that they are a biochemical product. On the other hand, UCC, Bayer AG (a West German chemical company which also produces MIC) and Dr. Jaeger of the WHO all state that the cyanide did not come from the MIC. If this is true, then there is the possibility that other gases leaked together with MIC.

Wherever the cyanide came from the controversy continued until the Indian Council for Medical Research stated that thiosulphate treatment could be given provided haemoglobin and urinalysis tests were also carried out. These conditions were satisfied in various hospital departments and so this treatment was continued on an essentially experimental basis.

A door-to-door survey on the after-effects of the accident, carried out by a community action group Zahreli Gas Kand Sangharsh Marcha in the last week of December 1984 in one very affected colony and one less affected colony, found that 75% of the workforce was incapable of work, insofar as their capacity to carry lads was reduced by one-third. Breathlessness among the poor manual laborers means that heavy physical work is now impossible or difficult so that their earning ability is reduced a situation that affects thousands. It seems that this chronic lung disease will become a permanent handicap. In fact, some patients subjected to sensitive lung function tests show definite signs of fibrosis, emphysema and bronchitis.

In addition, the respiratory tract may become hypersensitive to a variety of irritants. Such sensitized people develop acute allergic reactions to a secondary exposure, and this, even if mild, could prove fatal. Exposure to other irritants can also result in an acute reaction, as already witnessed by affected women working in a cigarette-rolling factory. These have been affected by small amounts of chemicals emanating from tobacco, which resulted in respiratory distress and asthma. Textile dust has also been reported affecting the lungs of victims.

A large number of pregnant women were exposed to the MIC and resultant hypoxia, infection, stress and drugs, each of which can cause damage to the fetus and result in miscarriage, stillbirth or birth defects.

A study to assess the health problems of women due to exposure to MIC was carried out by Dr. Rani Bang and Dr. Mira Sadgopal in Feburary 1985. This showed that 3 months after the disaster an extremely high proportion of women in two of the gas-affected slums has developed gynecological diseases such as leucorrhoea (94%), pelvic inflammatory disease (79%) and excessive menstrual bleeding (46%). Supperssion of lactation, impotence in husbands, still-births and spontaneous abortions were other such effects. The patterns of disease are so striking and so obviously clearly associated with exposure to MIC that it can be safely inferred that there are definite gynecological ill-effects from the disaster.

Some of these problems are especially important because of their sequellae. Women with pelvic imflam-matory disease generally have a 10-fold increased risk of ectopic pregnancy as well as anything up to a 60% chance of infertility. Ectopic pregnancy is always an emergency, even in the best of conditions in hospital surroundings. This then is a problem which should be closely monitored.

Excessive menstrual bleeding can result in severe anemia in already malnourished slum women, reducing their working capacity. These women clearly need added rations or at least iron and vitamin supplements. Like-wise extra rations are needed for those babies or mothers who found that their milk supply was supperssed. Suppression of lactation in 57%of those studied is alarmingly high; exposure to gas, stress or drugs could have been the cause of this, and often leads to malnutrition in the infants of poor women.

All these medium-and long-term effects imply that there may be delayed outbreaks of secondary diseases or effects-bronchial diseases, infections, pneumonia, tuberculosis and allergic conditions. The fact that MIC reacts with other organic molecules in the body to produce a large number of sometimes toxic products would tend to confirm such fears. The WHO and the Indian government have a heavy responsibility in monitoring developments.

MIC also gives this same reaction with water and various organic materials in plants. MIC reacts with water to form methyl amine which again reacts with MIC to form dimethyl urea. Methyl amina is also known to react with nitrates or nitrites, normally present in lake waters, to form nitrosamines, which are known cancer-causing agents.

Similar concerns regard the effect of the gas on vegetation, and more specifically, vegetables and fruit for consumption. The gas immediately affected trees surrounding the factory, causing visible damage in changing their colour and blackening leaves. Leafy vegetables such as cabbages showed white spots on their green leaves. In short, vegetable crops all showed signs of being badly affected. Theses short-and long-terms effects of the MIC pollution on crops and in water deserve to be intensively studied.

This section on the health effects of the MIC gas leak has purposely been kept brief, mainly because detailed accounts have already appeared in the press. Even this brief account, however, shows the strong need for more stringent regulations forcing companies to give exact information on the health hazards of the chemicals they use.

IMPLICATIONS

Was the Bhopal disaster unique, or could it happen again? Are the factors that led to the accident confined to Union Carbide , pesticide plants, india, or developing countries or are they common?

Union Carbide corporation (UCC) has had a checkered safety record. The company was involved in the worst single industrial health tragedy in American history. In 1930 and 1931, a Union Carbide subsidiary , The New

Kanawah power company . drove a hydroelectric tunnel near the town of Gauley Bridge, West virginia . The rock was almost pure silica, a fact well known to Union Carbide, since the company used the excavated rock in a nearby steel plant. The hazards of silica were well known in 1930, but the company took no precautions. A total of 476 workers died from silicosis(a dust disease of the lungs), Some after only a few months work. Many were buried in unmarked graves, with no autopsies or death certificates. Senator Rush Drew Holt of west Virginia later called the tragedy "the most barbaric example of industrial construction that ever happened in this world . That company knew well what it was going to do it these men. The company openly said that if they killed off those men there were plenty of other men to be had."

In 1978, a Union Carbide product, NIAX catalyst ESN, used in the production of polyurethane foam, caused severe bladder paralysis among workers handling it. Union carbide pulled the material off the market. It was later determined that. While Union Carbide had tested the acute toxicity of the main ingredient in rats, they had never bothered to autopsy the animals, and had thereby missed finding the bladder problems.

In 1970, a survey by the oil. Chemical and atomic workers Union (OCAW, affiliated to ICEF) in a Union Carbide Linde Division plant in Tonawanda, New York, uncovered seven causes of emphysema in an 18 worker department making molecular sieves. Union Carbide workers in other plants have been the victims of liver cancer from vinyl chloride, skin cancer from coal tarproducts and higher than average rate of leukemia and brain tumors from as yet unknown causes . Union carbide's international record is less well documented , but a Union Carbide battery plant in Indonesia has been charged with responsibility for severe cadmium of the surrounding community.

Fundamentally, however, Union Carbide is no different from other global chemical companies. All have experienced safety and healthy problems. In fact, a 1981 survey of the eight largest chemical companies in the U.S. ranked Union Carbide first in overall safety and health, based on goverment inspection statistics . Members of the mission familiar with union Carbide plants in other countries report them to be generally about as safe as any other chemical plants, Union carbide corporation and its Indian subsidiary were certainly responsible for the Bhopal tragedy, but the fault does not lie in any unique Characteristic of the company.

In the weeks following the Bhopal disaster, government around the world quickly initiated inspections of plants Making and using MIC. Union Carbide upgraded its safety systems in institute and other MIC facilities. One of UCC'S major American customers announced that it would build a new derivatives unit in Taxas. MIC is not a widely used chemical and the response to the Bhopal accident makes it unlikely that another large accident makes will happen in the limited number of plants using it.

However, MIC is only one of thousands of highly dangerous chemicals in use in Industry. Some chemicals, such as phosgene, chlorine, ammonia, cyanide, hydrogen sulfide and many pesticides can causes sudden death. Others, such as benzene, Vinyl chloride, and acrylonitrile can causes chronic disease, Including cancer. other chemicals are highly explosive; liquified natural gas killed 452 people in Mexico City on November 19, 1984, less than two weeks before Bhopal. The Flixborough accident, by dioxin, a substance usually present in the process in only trace amounts, but which escaped when the reaction went out of control Clearly, many different chemicals can causes major accidents.

Similarly, such accidents can happen in any part of the world. The disasters listed above happened in chemical accidents killing at least 200 people each have been documented in Brazil, Spain, Federal Republic of Germany, Mexico, the United States, and now, India.

The Bhopal disaster was caused by a combination of factors, Including the long term storage of MIC in the plant, the potentially undersized vent gas scrubber, the shutdown of the MIC refrigeration units, the use of the backup tank to store contaminated MIC, the company's failure to repair the flare tower, leaking valves, broken gauges, and cuts in manning levels, crew sizes, workers training, and skilled supervision. The accident might have been prevented if

UCC had done more to follow up its 1982 safety inspection, or of UCIL or the government had heeded the complaints of unions representing Bhopal workers. The effects of the accident were exacerbated by the company's failure to provide adequate information to its subsidiary, authorities and community residents, the siting of the plant close to residential areas, and UCIL'S lack of disaster planning.

The specific items which caused the tragedy and the specific way they came together on the night of December 2, 1984, were unique. But the underlying causes are not unique:

- Insufficient attentions to safety in the process design,
- Dangerous and irresponsible operating procedures,
-Inadequate maintenance,
-faulty equipment,
-cutbacks in manning,
-Inadequate training,
- Management and government unresponsivess to safety complaints,
- The Siting of potentially dangerous plants in heavily populated areas,
-lack of Information,
-Lack of disaster planning.

Members of the mission represent chemical unions and have visited chemical plants around the world, In our experience the factors that led to the Bhopal disaster are common.

Most government set standards for routine , day to day exposure to chemical. Some government have extensive enviornmental regulations. designed to limit normal emiissions of the air and water pollutants. However , those regulation are not designed to prevent catastrophic accident like Bhopal or Seveso or Flixborough . The conditions that led to the MIC release in Bhopal, had they occurred in the United states or in any of several other developed countries. Would not have violated any specific workplace or environmental standard . Unless better national and International regulations are written and strictly monitored by management and trade unions as well as by local . regional, national and international authorities, the next chemical disaster is only a matter of time.

RECOMMENDATIONS

If accidents like Bhopal are to prevented in the future, steps must be taken to address the problems that are posted by the production and use of hazardous chemicals and processes. These problems are not limited by national boundaries and will require attention and action by government, Industry, International organizations and trade union movement throughout the world.

Our recommendations for such action are follow are as follows:

Governments Must:

Established strict health and safety standards to govern hazardous substances and technologies giving special consideration to major accident hazards. Standards must include requirements for the proper siting and design of new production processes and equipment : institution of all necessary controls to prevent releases and accidents; monitoring and alarm systems; emergency plans for the worksite and community ; training of workers and supervisors; and appropriate transport and disposal of hazardous chemicals.
Adopt legislation and rules requiring complete information on the identity, hazards and control of hazardous chemical and process to be provided to workers, the general public and local medical authorities.
Institute an adequate system of inspection of hazardous processes conducted by trained personnel with the necessary

equipment and resources to do the job.

Chemical manufacturers, importers and users of hazardous chemicals and processes must:

Institute the safest possible operating procedures for hazardous chemicals or processes; proper design and control measures; maintenance of equipment and controls; adequate manning for safe operation; training of workers; limited storage of hazardous substances; and establishment of emergency plans for the worksite and community.
Provide all necessary training to workers, supervisors and managers who are responsible for the use or production of hazardous chemicals- in a language understood by them- about the hazards, proper operating procedures, control measures, and plans for emergency response.
Provide full information on hazardous chemicals and processes to workers- in a language understood by them- the public and purchasers of the substance and processes in all countries.
Provide the same highest degree of safety in all plants, in all countries in which they operate.

International Government Organization(i,e, ILO, WHO, OECD) must:

Develop comprehensive guideline for the use of hazardous chemicals and processes, giving special emphasis to measures to control major accident hazards.
Develop and distributes hazard and control information on chemical substances and processes for use by governments, employees trade union organization and workers, particularly in developing countries.

Trade Union organizations must:

Seek national laws and international instruments which guarantee workers and their representatives complete information on the identity, hazards and control of chemical substances and processes.
Established a unified trade union program for the control of major accident hazards; and seek the adoption of such a control program in all countries through national laws and international instruments.
Through their national centers and international trade secretariats, establish the chemical hazards to union members in all countries.
Promote the establishment of local safety and health committees and health and safety representatives to monitor the workplace, and institute training programs for these union representatives.

APPENDIX

Largely based on accident like Bhopal and Mexico City, ICFTU affiliates presented a resolution to the ILO'S annual Labor Conference in June, 1985. The resolution was adopted by the conference. As it represents to a great extent the will of governments, employers and workers, we include the text in full. It is our intention to push for the development of more effective national and international measures to improve safety in dealing with hazardous substances.

Resolution concerning the promotion of Measures against Risks and Accidents Arising out of the Use of Dangerous Substances and Processes in Industry.

> The General conference of the International Labor Organization.
>
> Expressing deep concern at the growing risks and the increasing number of serious accidents related to the use of hazardous substance and chemical products.
>
> Regretting that such accidents have in the recent past caused considerable damage and have led to the death of

several thousands of persons both insides and outside undertaking or serious injury to their health,

Considering that such tragedies demonstrate –

(a) the inadequacy of safety and supervisory measures and the lack of workers information and training concerning the hazards linked to certain dangerous substances and the technical processes that are in use;
(b) the correlation between workers' safety and that of the public and the environment,

Emphasizing that in the design and implementation of their industrial development policies, competent public authorities and industry should take fully into account the possible safety and heath effects of hazardous substances and processes on workers and the general public,

Noting with serious concern that in some countries and in particular the developing countries, substances continue to be used and produced, and processes introduced, which present risks and which have been prohibited or subjected to restrictions in other countries,

Emphasizing the basic responsibility of multinational companies central management over the organisation and control of the management of all their subsidiary units,
Considering that special activities must be undertaken in order to improve the control of major hazards and safety measures, having regard to the permanent dangers arising from the widespread use of chemical and other dangerous substances throughout the world,

Recalling the guide-lines regarding the protection of safety and health contained in the International Labour Organisation's Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy, as well as the provisions contained in the relevant international labour Conventions and Recommendations and codes of practice concerning occupational safety and health and the working environment,

Stressing that international labour standards on safety and health should be universally applies and strengthened, and stressing in particular that this resolution applies to the activities of all enterprises, multinational or otherwise;

1. Calls upon the governments of all States Members of the International Labour Organisations to adopt, in full consultation with workers' and employers' organisations, integrated and comprehensive policies for hazard prevention in connection with the use of dangerous processes as well as the production, transport, storage, handling and disposal of hazardous substances.

Safeguards to ensure that the introduction of new hazardous substances and processes are effectively monitored and covered by adequate health and safety measures;
the establishment of strict and adequate safety and health standards to govern, inter alia, the choice of substances and technologies to be used in industry; the location and design of new production processes and equipments; the setting up of safe hazard control and alarm systems in all chemical plants and facilities; detailed emergency plans for factory areas and surrounding communities; maximum permissible exposure levels for workers and local populations; the provision of adequate protective clothing and equipment at the workplace; the safe transport by air, sea and road as well as the safe storage of toxic chemicals and wastes;
the establishment of a centralised and independent national authority responsible for submitting recommendations concerning the granting of licences for industrial operations involving hazardous occupations and substances as well as for the import and introduction of new and potentially hazardous technologies and substances in industry;
the pursuit of international agreements on the export of hazardous substances and technologies, including provisions to stop importation of substances banned in other countries.

2. Further calls upon the government of States Members of the International Labour Organisation –

to re-examine the possibilities for a wider and more effective application of the provisions contained in the ILO Tripartite Declaration of Principles concerning Multinational Enterprises and Social Policy, as well as in other international instruments dealing with the economics and social responsibilities of multinational enterprises;
to encourage and stimulate effective tripartite cooperation in all bodies dealing with safety and health of workers involved in the production, transport, storage, handling and disposal of hazardous products and substances;
to issue adequate legislation and rules for full and clear information concerning the potential dangers of products and technologies to be provided prior to their marketing or export by producing companies.

3. Calls upon employers and company managements in chemical and other hazardous industries –

to provide for the safest possible operating and control systems in their enterprises and where transportation is involved, for the safest possible mode of transport;
to replace, whenever possible, dangerous substances and processes by safer alternatives;
to avoid or minimise the stockpiling of toxic and hazardous substances;
to ensure the exchange and dissemination of research information concerning safety and health particulars of hazardous processes and substances and their alternatives;
to ensure, as a matter of priority, that all workers, technicians and managers who play any role in the safety control system of the enterprise be given adequate specialised training for this purpose;
to provide to all workers in the enterprise, and in a language they can understand, the necessary training, information and instructions as well as equipment required for the protection of their individual and collective safety and health at the workplace.

4. Calls upon workers' organisations –

to contribute towards the improvement of safety conditions in industry by setting up health and safety departments and locating scientific, medical and legal experts for advice on matters of safety and health;
to elect safety and health representatives to monitor the workplace;
to initiate training courses for such representatives;
to establish more contacts between workers' organisations in the same national or multinational enterprises in order to acquire a better understanding of matters concerned with safety and health.

5. Invites the Governing Body of the International Labour Office to instruct the Director – General –
to make arrangements for ad hoc expert meeting –

(i) to identify and asses risks arising out of dangerous industries;
(ii) to advise the Office on

general safety measures specific to highly hazardous industries;
measures required to improve safety and health in the production, storage and transportation of dangerous substances;
the appropriate transportation standards and a code of practice;

to make every effort, through the International Labour Office's activities in the fields of technical co-operation, promotion of standards, research and information, to provide maximum assistance to member States for the establishment and strengthening of national infrastructures and institutions conducive to ensuring high levels of safety and health standards in the production, transport, storage, and handling of hazardous substances and to strengthen the International Labour Office's ongoing programmes in the field of

training in occupational safety and health;

to continue to put emphasis, in the context of Industrial Committtee meetings, on safety and health aspects of the introduction of potentially hazardous substances and technologies in the relevant industrial sectors;

to devote adequate attention and resoureces to the International Labour Office's participation in the International Programme on Chemical Safety carried out jointly with the World Health Organisation and the United Nations Environment Programme, and to pursue maximum strengthening of cooperation with other relevant United Nations agencies for the improvement and effective application of international standards in the field of hazard control and accident prevention as well as the protection of the safety and health of workers employed in chemical and other potentially hazardous industries;

to continue to submit proposals to the Governing Body for the inclusion in the agenda of future sessions of the International Labour Conference of technical items dealing with acute safety and health problems in chemical and other hazardous industries with a view to the strengthening of international labour standard in this field and in particular to examine the possibility, as a matter of priority, of including the subject of hazard control and accident prevention related to the use of hazardous substances and processes in industry in the agenda of an early session of the International Labour Conference.