Train Dispatcher in London at 01:49, Dow's Emergency Co-ordinator put together a CHLOREP team by 03:15, consisting of two chlorine experts, one fire expert, and a public relations advisor (See Section 2.2.9.). Communications between Dow's Co-ordinator, CP Rail, the Mississauga Fire Department and Cyanamid RCC (the TEAP centre for Mississauga) confirmed the site of the derailment, the probable cars and their contents, and possible emergency response routes. The team left in an emergency vehicle with small patching tools and protective equipment at 03:30, arriving at 06:30 hours.

The team confirmed both the actions that had been taken so far and the existence of the chlorine car in the derailed section of the train. It was also confirmed that the car was leaking. They were then incorporated into the first meeting of the Control Group held at 07:30, to decide whether Mississauga Hospital should be evacuated.

3.3.4. The Decision to Evacuate Mississauga Hospital

This decision was perceived by most of the participants in the decision-making process as a watershed. The feeling was that it was now theoretically possible that more people could possibly be harmed by the evacuation than by the hazard of the derailment. Before the crucial meeting to determine if the proposed evacuation should go ahead, Chief Burrows had contacted the President of the hospital, Merit Henderson, by telephone at 07:25. According to the report of the hospital staff in the evacuation, the Police Chief indicated that there was a problem with chlorine gas and the continuing propane burn. The President was reluctant to move the seriously ill patients; however, he indicated

> *"the hospital would comply with an evacuation order since the Police Chief had a better understanding of the danger from his vantage point at the scene of the crash".*
> (Mississauga Hospital, 1980)

Ambulances would be moved into the area, and a formal call would be made by the Police Chief when the decision was made.

Burrows, Fire Chief Bentley - who came on scene for the meeting - Mayor McCallion and Chairman Bean were among those present, as well as the recently-arrived Dow experts. There was an updated weather report form Malton Airport, suggesting that winds would be · 6 km/hr from the north. That was the most accurate technical information available. "Back of the envelope" calculations were the norm until substantially later in the day. Stu Greenwood of Dow Chemical, after conferring with the Chlor-Alkali Unit Manager in Sarnia, recommended an evacuation of the hospital, as did the rest of the participants. Once again, the final decision appears to have rested with the Police Chief, based on the knowledge and advice of the available key actors.

When the stand-by alert to Mississauga General and the adjacent Chelsea Park and Extendicare nursing homes had come (at 06:50), the Ambulance Services Branch of the Ministry of Health in conjunction with the Halton-Mississauga District Ambulance Service and Metro Toronto Department of Ambulance Services assumed responsibility for:

(a) canvassing region hospitals for available space;
(b) helping to set priorities on patients;
(c) marshalling all available ambulance units.

This was backed up by an additional province-wide system of ambulance services, using the provincial ambulance co-ordination centre at Oak Ridges to marshall and organize a large-scale response in major emergencies.

Chief Burrows has stated that he had had experience with the ambulance services at the recent air crash at the International Airport in June 1978, and he had confidence in their ability to get large numbers of ambulances to the scene. Without that confidence, he said, the decision would have been a great deal more difficult.

As it was, there was recognition of the difficulty involved:

> *"For instance, your lead time at the hospital; it will take six to eight hours to clear. It's never been done before. You have to commit yourself an hour ahead of time, at least, as lead time. The lead time is to get the ambulances up."*
>
> (Inspector MacDonald cited in The Globe and Mail, November 17, 1979)

Ambulance Services began canvassing for ambulances from as far away as Kingston. By 08:30, 50 ambulances had arrived at the hospital, awaiting the evacuation order.

3.3.5 Evacuating Mississauga Hospital and Nursing Homes

The evacuation of Mississauga Hospital and adjacent nursing homes (which proceeded through the rest of Sunday morning) was a model for the further evacuations of other hospitals and nursing homes later in the day. Its success suggested that the expected eight hour time requirement for such an evacuation could be cut in half if enough personnel and ambulances were available.

Three agencies were primarily responsible for the evacuation: Peel Police, the Ambulance Services Branch (of MOH) and the staff of the Hospital and nursing homes. There was no emergency plan for evacuating a hospital in any of these three groups, so the response was a hybrid of the emergency plans that were available. In particular, Ambulance Services had procedures for moving seriously-ill patients from one hospital to another, and they also had procedures for dealing with mass emergencies. In the event, the "sending" hospitals were treated as if they were point sources for mass emergencies; while the "receiving" hospitals treated the incoming by modifying emergency procedures for treating great numbers of casualties.

Fifty ambulances were at Mississauga Hospital by 08:30, when the hospital evacuation was scheduled to start. Ambulance Services was also charged with locating and assigning spaces for patients in the hospitals that were to receive them; with

organising the travel routes; and with the loading and unloading of ambulances.

Inside the Hospital, discharges were given to some patients,and supervisors went floor by floor assessing the state of patients, giving priority to intensive care patients. Some patients were discharged at the Day Surgery entrance, while ambulance pick-up was scheduled for the Emergency Department. The evacuation proceeded (after intensive care patients were moved) from the ground floor up. Complete medical records were taken with each patient. The ambulances were directed by joint communications from the Halton-Mississauga Ambulance Service and the Hospital Associate Director of Nursing.

The Police, who installed a communications unit in the Hospital, were responsible for clearing traffic routes and for overall control. Altogether, 537 patients and senior citizens from the nursing homes were moved, 186 from hospital to hospital.

Subsequent evaluations have suggested that the four hour evacuation time could have been reduced by having two patients per ambulance and by calling in many more vehicles. Had there been a substantial number of casualities from the derailment, however, the evacuation could not have proceeded so smoothly.

3.3.6. Expanding the Response

By the time of the series of early-morning evacuations and the evacuation of Mississauga Hospital, the Police Command Post operations had moved to the permanent site at the Bell Centre north of the site. The fire was stabilised; MOE water and air sampling teams were in the area. The major problems for the organisational response on-site were the management of concurrent evacuations (residents and hospitals), and the incorporation of more and more elements of outside agencies into the command structure.

Management of the first problem required dependence on the ability of volunteer agencies to open and man new evacuation centres, and on the interlocking of various police forces (now approaching 500 officers and constables) in a pattern of independence within the Police Disaster Plan - exemplified by the policy of not assimilating other forces to Peel Police units. It also depended, as Chief Burrows has said, on the confidence he had in the ability of Ambulance Services to fulfill its part of the Hospital evacuation.

The second problem, incorporating outside elements, had two aspects: one, the transfer of authority; and two, the provision of priority information. It appears that the news of the derailment passed through OPP Commissioner Harold Graham, who was awakened at 04:30 and called Deputy Minister John Hilton. Solicitor General Roy McMurtry was informed of the derailment between 06:00 and 07:00. He has since commented that the system should have relayed the information to him somewhat sooner. It is uncertain whether there was a consultation with any other Cabinet colleagues or the Premier before McMurtry proceeded to the scene, arriving at 09:28.

The alert of Ministry of the Environment officials proceeded in a different manner, most obviously because, in the case of the Solicitor General's office, a vast array of police personnel and equipment was already in action before senior provincial officials were required. In MOE's case, the environment representatives on-scene were only gradually compelled by circumstances to move from an advisory role to a full-scale technical sampling and monitoring effort. Ron Graham and John Barr (Oakville office) were the regional representatives already on scene, with an MOE Duty Officer (P. Roussel) and Mr. Bartkiw, the District Officer for Peel and Halton, as the telephone contacts. The telephone contacts had been taking reports from the on-scene representatives through the night, and also fielding questions from the public.

MOE's Air Resources Branch became alerted partly because of a rumour about the presence of PCB's in the wrecked tank cars. Dr. E. Singer, a unit head at MOE, was up early to go fishing and read about the derailment and possible PCB's in the Sunday Sun. He telephoned Gregg Van Volkenburgh of the Monitoring Unit, Air Resources Branch, at 06:45 a.m. Slightly earlier, Tom Cross, the Director of the Branch, was telephoned by the executive assistant to the Deputy Minister about the possibility of marshalling monitoring equipment.

It seems that someone in the Solicitor General's Department contacted the Deputy Minister. The Regional MOE Office did not pass the alert to the provincial office. Cross then telephoned Van Volkenburgh to discuss the appropriate response to the emergency, involving the deployment of Trace Atmospheric Gas Analyzer (TAGA) vehicles (Section 2.2.12). Organizing the TAGA crews took until 10:00 Sunday. Cross meanwhile contacted officials of MOE's Contingency Planning Section, and Dr. Max Fitch of the Ministry of Labour's Special Studies and Services Branch.

Tom Cross and Dr. Fitch both remained at their homes for most of Sunday. The on-scene senior MOE personnel were Garnett Kay of the Contingency Planning Section and George Trewin of Central Region, (arrived 09:45), both of whom considered themselves as support for the regional people and as advisors to the overall effort. Graham, Barr and P. G. Belling from the Contingency Planning Section conducted water quality samplings in Wolfedale Creek and in the Mavis Road ditch (08:00-10:00). Other MOE sectors becoming involved included the Meteorological Services who were called in for their forecast capability, and the Industrial Abatement Section.

For the Ministry of Health, alerts proceeded through the dispatch centres of the various ambulance services, and primarily focused on the initial response, and the evacuation of the hospitals. Senior MOH officials were alerted by Dr. MacBride, the Principal

Program Advisor of the Emergency Health Services. He was given authority to do what was necessary from the Ministry perspectives by the Deputy Minister. MacBride was involved in the early Sunday afternoon meetings on-site and in Oakville. One of his functions there was assisting in setting up an emergency medical section on-site for the officials and workers. This was done through the Ontario Medical Association, and Dr. Galliver of St. Joseph's Hospital, Toronto.

In the case of most of the organisations that now sent representatives to the scene, there was a need to have a liason with the Command Post and someone in charge of the response - occasionally they were the same person. For a key group such as the Ministry of the Environment, the configuration became:

(a) Regional MOE staff on-scene sampling;

(b) Central Region staff for liaison with MOE provincially;

(c) Contingency Planning Section representatives;

(d) Subsections of MOE fulfilling technical functions (eg. Air Resources Branch sampling and modelling);

(e) Minister and Deputy Minister at EOCG meeting;

(f) Media liaison.

As the emergency progressed, most agencies (like MOE) sought a balance between looking inward to the Control Group and looking outward to their own responsibilities.

For all of these reasons, it was inevitable that a proto-cabinet with representatives of each working agency would be formed, to sort out priorities and control the myriad operations being undertaken. In this instance, Solicitor-General Roy McMurtry (in charge of the lead Ministry) very swiftly supported the police command structure already in place, and moved toward a more structured management system. McMurtry's arrival initiated a new series of meetings that were to last for the rest of the day. McMurtry became the chairman of the Control Group, and, although he could be considered as the ultimate authority on scene, he tried to leave the impression that he was merely first among equals, canvassing

all opinions and requiring cabinet-style unanimity for decisions taken by the group. In retrospect, these numerous Sunday meetings were part of the slow evolution toward the stabilisation of organisational response.

3.3.7. The series of decisions to expand the boundaries of the evacuated area.

The process of decision-making during the rest of Sunday was based on:

(a) the control of the outflow of evacuees;

(b) the appropriate boundaries for evacuation;

(c) wind shifts and, later in the day, technical modelling.

Decisions were made by the Control Group, chaired by the Solicitor General.[1]

The first evacuation orders were smaller than those which began after daybreak. Times and estimated numbers of evacuees indicate that the police felt they could move 20,000 people every hour if necessary. The procedure was based on setting evacuation zones based on recognisable street or geographic boundaries, and preparing areas not yet evacuated in advance of alert. Three factors made decisions easier:

(a) successful evacuation of some areas had already been carried out, and officers were now well rehearsed in the techniques of mapping and evacuating an area;

(b) the available police personnel had been supplemented so that operating strength was now over 500;

(c) as people awoke on Sunday morning, the public media began to play a substantial role in broadcasting advisories.

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[1] *The chronology of the numerous evacuation decisions throughout the rest of Sunday is provided in Sections 2.2.14 and 2.2.17; a map of the evacuation zones is provided in Figure 2.5; and a list of the times at which evacuation decisions were made on Sunday, and the numbers of people involved, in Table 4.4.*

As mentioned (Section 2.2.16), environmental monitoring and modelling were at a rudimentary level until the middle of Sunday afternoon, so that decisions were based on the same environmental criteria as were in force earlier. Since the direction of the plume was the most concentrated area of serious hazard outside the site, changes in wind direction were critical at varying decision times. Square One Shopping Centre, for instance, at risk if the wind shifted, had to be closed, and the evacuees sent to other Evacuation Centres.

During this period, there was a slow increase in the amount of information available on which to base decisions. By the time Queensway Hospital was ordered evacuated at 15:40, decisions began to be made on the basis of expert modelling. Certainly, the reports of the meetings held between hospital officials and the Control Group emphasised the possibility of a serious explosion on site giving only 15 to 20 minutes of evacuation time.

The components of this modelling process dovetailed as follows. The TAGA 2000 and 3000 units arrived on scene at approximately 12:30, and were immediately sent downwind to survey the plume. At 14:47, the first results from the Sciex TAGA were reported by radio (one delay to the start of monitoring had been the inadequacy of the radios in the trucks: portable units had to be added). An instantaneous reading of 100 ug/m^3 of chlorine was recorded at Dundas Street and Mavis Road. This can be compared with the official acceptable chlorine concentration of 30 ug/m^3 over a half hour period. This information was relayed to George Trewin, the MOE Command Post Liaison at the time. Meteorological information was provided by a joint working team at Malton Airport, made up from the meteorological section of MOE's Air Resources Branch and the federal Atmospheric Environment Service (AES), Ontario Weather Centre (each of which added more personnel to their standard complement).

The first request for special weather predictions came to AES at noon Sunday, but the Canadian Meteorological Centre (CMC) in Montreal had heard the news of the derailment and was already

at work plotting a wind trajectory. The first projections were received at about 13:15. The CMC model was based on predicting movements of pockets of air for purposes of air pollution transport modelling, and was not suited to modelling releases from a fire, or from an initial high trajectory. In addition, weather forecasts were only available twice a day - midnight and noon - with a falling off in accuracy in between. The other available modelling unit was the Dow Chemical computer in Midland, Michigan, which also provided plume models.

At this time (13:00 - 15:00), the winds were from the north-northeast at 20-25 km/hour, and were expected to drop to less than 10 km/hour as the day progressed. Consultations between Trewin (MOE), Dr. Fitch (MOL), Dr. Cherkas (MOH) and others failed to confirm a safe, short-term maximum ambient level for chlorine. Different levels were used in the computer projections: MOE used 3 ppm; Dow used 1 ppm. MOE calculations (by J. Wieder) showed that 30 ppm would be expected approximately 21 km. away under present conditions. Dow Chemical suggested the same for 15 miles (24 km. = 15 miles). All these calculations pre-supposed the presence of something like 80-90 tons of chlorine still in the tanker; it was not known until late Monday night that 60% of the chlorine had been expelled in the first hours after the derailment.

Taking all these factors into account, and also acknowledging the difficulties inherent in plume calculations, it is worth speculating here that the officials on-scene would have had some justification for evacuating out to a radius of 25 km.: in other words, using the worst possible case based on their knowledge as of Sunday afternoon, the Municipality of Metro Toronto at least as far east as Yonge Street might have been evacuated.

The evacuations of the far western boundaries of Mississauga in the early evening were primarily based on a predicted wind shift to the east (blowing west) that would take place during the night. Police were unhappy about the prospect of having, once again, to move people in darkness in case of an explosion. The last substantial evacuations, of East Oakville and Oakville-Trafalgar Memorial Hospital, were authorized by Halton Regional Police who made the

decision after consultation with officials at the Command Post, and hospital and ambulance officials meeting in the Mayor's office in Oakville.

3.3.8 Toward Control

As one senior participant in the Control Group meetings remarked:

> *"We found ourselves on Sunday evening having almost by accident completely evacuated a major city."*

This is, as much as anything, a comment on the smoothness of the evacuation operation as conducted by the immediate response agencies (not to mention the mobility of the people of Mississauga). To the people on-site, priority began shifting from getting people away from the hazard, toward both maintaining the furthest extent of the cordon consistent with safety and taking steps to alleviate or eliminate the problem. Although, as has been noted, the evacuees were not advised that they might be out of their homes more than twenty-four hours, it was clear by Sunday night that putting out the fire and patching the chlorine car would take at least another day. In consequence, the agencies on-site began organising shift systems and internal briefings which would allow the components of larger organisations to become relatively autonomous entities dealing with the derailment. Much of this was directed, not towards the maintenance of senior personnel on site - though this did happen - but towards continuing to provide information to the Command Centre group. It was a shift away from the provision of personnel and equipment as the priority. This was justified because the maintenance of the cordon and the resolution of the problem now depended on technical expertise and sophisticated scenario modelling. It is this which more than anything else characterises the "middle period" of the week, and is the focus of the next section.

3.4 EMERGENCY CONTROL STRATEGIES

3.4.1. The Holding Pattern

The decisions made on Sunday were complemented by a growing peripheral network of specific agencies, technical support, and affected citizens. Having brought this network into being, the primary tasks of the "controlling" phase of the emergency were the management of the network's constituent parts, as well as the determination to eliminate the chlorine hazard as swiftly as was consonant with safety.

3.4.2. The decision to reorganise the Control Group

The reorganisation of the Emergency Operations Control Group marks the point at which a hitherto loosely defined management structure became clearly divided into an inner core group, and an outer group which could be called upon to "report" to the inner group. In itself, this was merely the most visible of the series of organisational decisions clarifying the already existing relationship among the participants on site. Shift systems and relief of personnel had now come into effect, with agencies such as Atmospheric Environment Service providing site-specific weather information at regular intervals. In addition, other agencies had begun to assist the Command Post by relieving it of certain duties; for example, Peel Region Social Services arranged on Monday to set up an Emergency Information Centre to answer questions from the public and to relay information (see Section 4.3.9.).

The time, place and participants in the decision to limit the group are unrecorded, but it is clear that the central members of the Control Group including Chief Burrows, Mayor McCallion, Chairman Bean and Solicitor-General McMurtry were involved. There had already been complaints about the unwieldy nature of some of the meetings held on Sunday. A further factor was the opening of the upper storey of the Bell building, which allowed for greater seclusion from the media, police communications and agency personnel.

A list was drawn up and read out at the beginning of a meeting at 16:10 on Monday afternoon. There were complaints about the size of the meetings later in the week, but there was also general recorded agreement about the increased effectiveness of the group following the restriction. Meetings and news conferences were now regularised and somewhat later in the week, provision was made for recording meetings as they proceeded. The only negative result was that some useful personnel had difficulty getting access to the meetings.

3.4.3. The Chlorine Car

Even before the fires went out, the emergency entered a new phase, since the senior members of the CHLOREP team had made an initial survey of the chlorine car. The results of this survey indicated that a substantial amount of the chlorine had been expelled during the first explosions following the derailment and that the tear in the chlorine car was substantial. For the Control Group, the first piece of information meant that a reduction in the evacuated area was feasible. For the CHLOREP team, the second piece of information was, if anything, of more importance, since it meant that the Mississauga derailment did not fit into the standard pattern of chlorine tank car derailments (involving small punctures or tears).

The consequences of this information were far-reaching: the CHLOREP team was forced into improvising their operations while, for their part, the Control Group felt prey to a premature optimism. One problem was a lack of communication between the Control Group and the CHLOREP team in these early stages, partly because a codified system for reporting and evaluating activities on site had not yet been established. From the evidence, all relevant agencies were not notified about the expulsion of the chlorine (especially the Ministry of the Environment) and the Control Group failed to appreciate the difficulties in patching the chlorine car itself. This is attributable to the assumption by all parties on site that each party was capable of handling

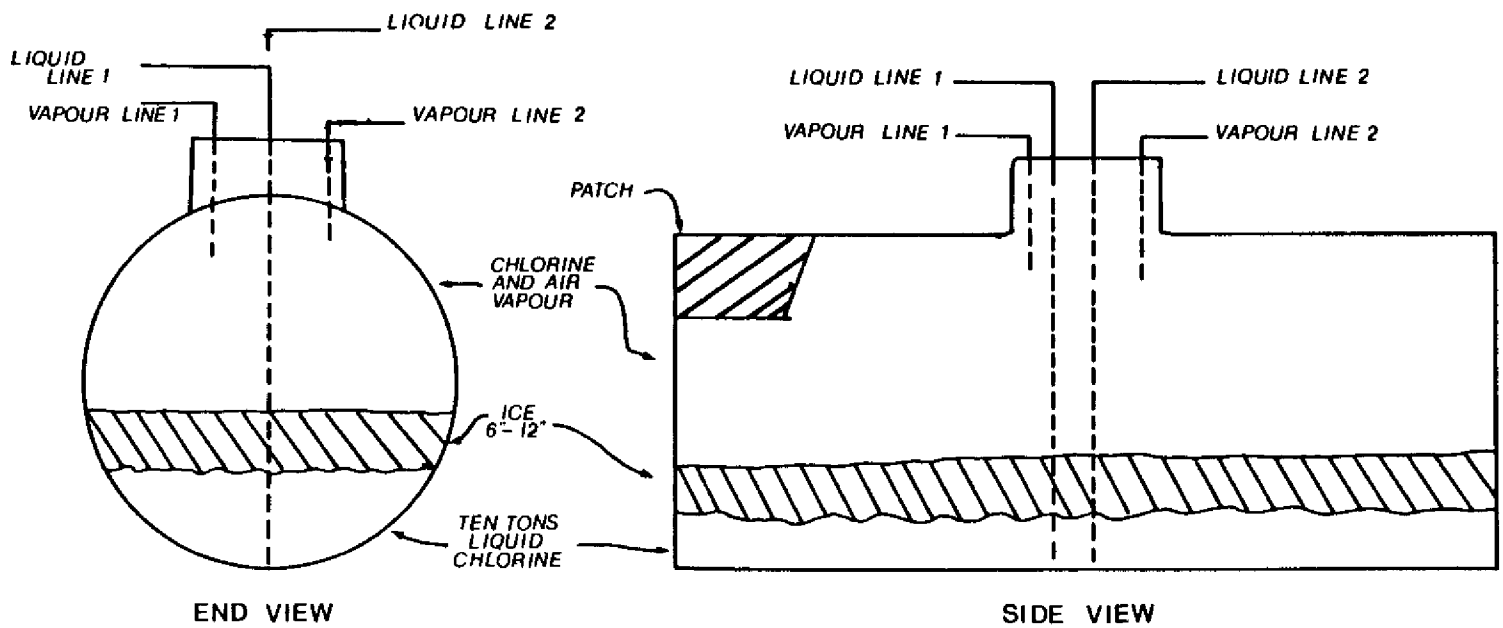
its role in the response without outside scrutiny. In retrospect, it was this confusion that sowed some of the mistrust between parts of the Control Group and Dow Chemical that would come out into the open later in the week.

3.4.4. The decision to allow some re-entry

There is little record available of Tuesday's Control Group meetings. The session, which began at 08:20, to consider the question of allowing at least some re-entry to the evacuated area, took place in the context of a number of new problems; for instance, evacuees who had assumed the evacuation would last a day or less were beginning to harass police at the perimeter (see Section 2.4.1). However, the meetings of the Control Group on Tuesday have been characterised as optimistic, and supportive of the CHLOREP team. With the team attempting to patch the chlorine car, it was expected that the situation would be resolved very shortly and the chlorine car would pose no threat to the population. The most important secondary information was that the hazard itself had substantially diminished - that is, the amount of chlorine remaining in the tank car was much smaller than was previously thought.

The decision to allow some residents to return, but not others, was made by the Control Group augmented by Environment Minister Harry Parrott and Health Minister Dennis Timbrell. Chlorine was still escaping from the leaking tanker, and contrary winds made prediction of effects difficult. However, it was deemed unlikely that harmful chlorine concentrations would be found on the fringes of the evacuation zone. Background readings at this time ranged from 1.2 to 2.5 ug/m^3, with winds at 8 to 10 km. from the northeast. Nevertheless, it was decided that people would not be allowed to return to the central zone until the chlorine leak had been plugged and the car drained. The re-entry boundaries may have been slightly over-optimistic, since concerns over the safety of a re-entered zone southeast of the site (just east of Highway 10) surfaced later in the week.

FIGURE 3.3 SKETCH OF THE CHLORINE TANK CAR



SOURCE: CONTROL GROUP SKETCH

3.4.5. The evaluation of the CHLOREP team

Just as the problems of unwieldy meetings had brought a management focus to bear on the Control Group, so the failure of the patch and the inadvertent release of what may have been a puff of chlorine on Wednesday morning (Section 2.5.1.) brought out into the open the problem of managing the work of the response agencies on-site. As noted, the general assumption to this point was that there was no need to supervise closely the agencies at work, now including CP Rail, Superior Propane and Dow. The conjunction of events on Wednesday morning caused great consternation in the Control Group. The Fire Chief ordered a halt to all activities by propane and railway crews for a review period.

The Wednesday meeting of the Control Group began shortly after noon. Mayor McCallion complained that the CHLOREP team was not available, and that they had not provided for a back-up team to continue the work while they rested. She complained that no one was managing the disaster (that is, the derailment). There developed a general suspicion that the CHLOREP team was receiving contrary instructions from Dow Chemical. As Roy McMurtry described it later:

> *"I thought there was lot of corporate paranoia at Dow and the men on the scene were obviously getting orders from the corporate boardroom to say as little as possible to anybody and that was upsetting."*
>
> (quoted in Cahill, 1980)

As a result of these problems, Greenwood, the CHLOREP team leader at that time, came under stern interrogation when he finally arrived at the "think tank" meeting. Additional members of the team were asked to be on-site, and a 24-hour-a-day surveillance by a CHLOREP member was to be instituted. The Air Resources Branch of the Ministry of the Environment would henceforth scrutinize the CHLOREP plans; the Branch now became the "lead agency" and, in effect, took charge of the pumping operations. The first

consequence of this was a meeting between Van Volkenburgh, Cross, two experts from the University of Toronto, and an expanded CHLOREP team, on Wednesday evening. Cross has described it as a general enquiry into CHLOREP's expertise, and Van Volkenburgh recalls it as *"taking everything back to square one"*.

3.4.6. A New Emergency Response

This new pattern of organisational response created in its turn a closer relationship between the response agencies of fire and police at precisely the time when the question of the transfer of liquid chlorine from the tank car into caustic soda trucks became critical. In addition to their duties maintaining the site and the evacuated areas, the response agencies were responsible for planning for a new contingency - the possible release of chlorine during the transfer. This transfer depended on the ratification of the CHLOREP team's plans by the Control Group.

3.5 EMERGENCY RESOLUTION

3.5.1. The decision to allow liquid pumping

At Thursday's "think tank" meeting, the CHLOREP team was asking permission to suck out the remaining 7.5 to 10 tons of liquid chlorine. There were a number of problems and possible dangers, of which the greatest was the possibility that the mixed layer of ice over the liquid chlorine might collapse as the liquid chlorine was sucked out (see Figure 3.2). It was believed that there was already a gap between the layer of ice and the top of the liquid chlorine of a few inches. If the ice layer collapsed of its own weight into the chlorine, the exposed liquid chlorine would vaporise. The likeliest possibility was that the vapour lines already in place would be able to take up the sudden addition of gas. Another possibility, the worst case, was that the pressure of the altered situation inside the car would blow the patch off the gash in the tanker. There would then be a substantial release of chlorine into the atmosphere.

The first half of the Thursday meeting was taken up with an explanation of the situation. It was decided to run a computer model to get an idea of the safe radius in a possible worst-case scenario. An hour later, Van Volkenburgh of MOE returned with the MOE model, and reported that Dow Chemical was running a similar model. The Ministry's model was a "puff" model - a sudden release of 60 kilograms in one second; while Dow modelled a continuous release of 60 kilograms a minute. The calculations were based on a wind speed of 10 kilometres per hour, and a specific height release of 10 metres. The Ministry's results were 25 ppm at 2 kms. for 80 seconds; while Dow predicted 2 ppm continuously at 1.6 kms.

As the acceptable limit for exposure to chlorine had already been set at three parts per million for fifteen minutes for industrial workers, it is clear that there was some possibility of serious risk to persons as far as three kilometres from the site. Complicating the matter further, the wind was blowing from the west due east. The wind was forecast to change to the north at 22:00 for a period of seven hours. There was therefore insufficient time to remove the entire remaining quantity of chlorine from the tank car.

The main consideration was, of course, the remaining evacuees now out of their homes for five days. Maintaining the cordon became increasingly difficult, and much police time was now spent either conciliating those who appeared at the lines or ferrying people back and forth from the lines to their homes. As Chief Burrows remarked:

> *It's not easy for the people, but it's very difficult for us to keep them out as well without using enforcement which the people may not think we have the authority to use, and the law is not clearly defined in that area.*
>
> (Control Group Meeting Transcript)

For the Control Group, the issue of the evacuees had also become the issue of their own competence and authority. One clear result of this was the determination to be as sure as possible,

not just about the minimization of risk, but about the theoretical justification for each decision. Thursday's meeting records a long and difficult debate about the nature and determination of risks.

It is also quite clear from this record that the strongest constraints on free action by the participants at this stage involved both the tiny fraction of people who had refused to evacuate, and the section of re-entered people southeast of the site. The new contingency plan for re-evacuation depended heavily on their presence.

It was finally decided by the Control Group to allow the draining, but to postpone the transfer until after 22:00; it could then proceed, provided that no pumping began without the express authorisation of MOE.

With the decision to pump ratified, the deployment of immediate-response agency personnel began, with the Fire Department prepared to create a curtain of water in case of a leak, and the Police Force prepared to race through the streets ahead of the hazard, warning the residents to evacuate. Plans were drawn up to move the Command Post to Burnhamthorpe Road. Sound trucks would go again through the streets. RCMP, OPP and MOE personnel would be stationed at various points around the perimeter of the site (see Section 2.6.1.).

For these agencies, Thursday night could have been - in a limited sense - a replay of the previous Sunday's events; and the mounting of this preparedness, with its interlocking communications and response network, was a tribute to the now smoothly integrated management structure on-site.

3.5.2. The decision to allow final re-entry

With the transfer of chlorine largely completed (see Section 2.7.1.), the last major decision was dependent on the simple time-table for final elimination of the remaining chlorine. The Control

Group meeting which convened at 10:05 Friday was forcefully reminded of the insistent pressure being brought to bear by the remaining evacuees. A Mr. Karskavitch of the Canadian Transport Commission had been quoted in the previous evening's Toronto Star as saying that:

> *....the danger had passed and he could see no reason why the rest of the evacuees could not move back today.*

The nature of the danger, and the pressures at the perimeter, were thus placed side-by-side right at the start. Mayor McCallion stated flatly that nobody was in control of managing the technical aspects of the emergency, while the Solicitor-General suggested that:

> *The situation has been pretty well under control from the early hours of Friday morning.*

Others noted the prospects for an eventual inquiry into the week's events.

All these concerns had an impact on the quality of the rest of the meeting, which, after a technical briefing, was spent in an attempt to provide a systematic rationale for allowing the re-entry of people into the central zone around the derailment site, a zone that could not be guaranteed 100% safe until the chlorine car was completely empty. This might take another two or three days. The Control Group used the previous meeting's decision-making process as the standard by which to judge the merits of the present decision. The Solicitor-General noted that the high-risk period in pumping out the liquid chlorine had been at the beginning of the operation, and went on to say:

> *Having had the benefit of 14 hours....the risk, while not entirely eliminated, has become increasingly remote, and all we can do if there is a puff is follow it, alert people....We've never said there is a 100% guarantee because, but again, we've avoided trying getting right down to the bottom line because it's like any one of us deciding what risk we're taking every time we get into our automobile.*

Winds were expected to blow to the north for the next 24 hours; only two tons of chlorine were estimated to remain; and a vacuum pump hookup could be activated in case of sudden releases.

Agreement was reached that evacuees west of the Credit River and south of the QEW could return, but that police would once again be deployed downwind (north of the site) in case of any release of gas during the transfer. Until the liquid lines on the tank began drawing vapour, a "buffer zone" around the derailment site would remain (see Figure 2.6).

When this happened, an unrecorded meeting of the Control Group allowed the final re-entry into the central zone (see Section 2.7.1.) The management problem was now reduced to making the return as orderly as possible, a responsibility once again devolving on the police and on the Ministry of the Environment and Public Health monitoring teams who responded to alarm calls from returning residents concerned about possible concentrations of chlorine in their homes.

3.5.3. Management and Clean-up

Inside a strict cordon around the derailment site itself, the CHLOREP team and the CP Rail crews spent a further four days transferring the last of the chlorine and removing the car. This was the beginning of the "clean-up" phase, and it coincided with the steady reduction in other emergency personnel around Mississauga. Ministry of the Environment and Fire Department personnel were the major monitoring agencies during this period, while other agencies returned to normal.

Analysis of contaminated seepage from the rail bed, and final removal of 30,000 cubic metres of contaminated soil were the last official organisational activities related to the derailment. Detailed analysis by MOE representatives of the soil continued for some weeks, and became part of controversy surrounding the removal of the soil.

Ultimately, however, the important organisational response in this phase of the derailment was the review and incorporation of lessons learned during the week's events. For some agencies,

such as AES and the Ministry of the Environment, Mississauga served as a revelation of equipment deficiencies and of broader conceptual difficulties associated with the fact that they were now in the business of responding to emergencies. Contingency plans and emergency equipment have since been put into place.

For other agencies - especially immediate-response agencies, e.g. Police, Fire - operational lessons have been combined with a new awareness of other agencies. For example, the new Peel Region emergency plan is designed to streamline alert procedures between immediate response agencies and support services. At the provincial level, attention has been focussed on the problems of municipal emergency response, with the result that new legislation is being proposed to fill the legal vacuum within which response to emergencies now operates.

Most important of all, Mississauga's derailment has brought out the growing problems posed by the transport of hazardous materials along increasingly urbanised transportation corridors. The resolving phase of the organisational response is not finished.

3.6 EVALUATION OF THE ORGANISATIONAL RESPONSE

The success of the organisational response was due, in large part, to often-exercised and therefore appropriately tailored local emergency procedures. During the immediate response, or "tactical" phase of an emergency, speed is the essential characteristic, including speed of arrival of personnel and equipment, and speed of initial correct assessment of the magnitude of the emergency. For this reason, emergency plans for organisations responding to this phase of an emergency are, of necessity, detailed and specifically directed. For the initially responding agencies - police, fire and ambulance - plans of this sort are a fact of daily life; and no serious criticism can be made of what were their own operational strengths.

The transition from short term response to longer term control cannot easily be organised in detail beforehand. It is enough to have planned the potential for creating a workable managerial structure. As the police response was the core around which the structure of control grew, it was clearly advantageous to have a structure embedded in the Police Disaster Plan, which itself was versatile enough to monitor the event, establish media liaison, and expand to include the Emergency Operations Control Group; this was the Police Command Post. While this part of the transition worked well, even in the face of what could have been jurisdictional disputes, other parts did not. The reasons can be traced back to the fundamental problem of shifting from internal emergency response procedures to inter-agency emergency response procedures. For whatever reason, the integration of local social services into the response was not carried out early enough, and was never carried out completely during the week. It is understood that this situation is being rectified in the new Peel plans.

With the broadening and lengthening of the impact of the derailment, the handling of the off-site social and political concerns became as important to a successful resolution of the event as the removal of the physical threat. This called into play a new range of key actors, whose managerial and political skills were successfully integrated into the command structure. In addition, the key actors already on-site were drawn more and more into combining a managerial with an emergency response function. This was facilitated by the managerial roles already being played by the heads of the immediate response agencies.

One interesting quality of the Mississauga derailment was that at the same time as the transition from immediate emergency response agency to managerial agency was proceeding in, for example, the Peel Regional Police, the reverse was occurring in other agencies as they became suddenly aware that they might have to create an immediate (and previously unplanned) emergency response

capability. The problems relating to the MOE Air Resources Branch and Atmospheric Environment Service have been singled out; but a similar situation occurred at other points. They can also be traced back to a fundamental element in successful emergency planning: imagining how resources might be called upon in a variety of circumstances. Imaginative flexibility before an emergency is as important as flexibility during the emergency in ensuring that resources will be available on demand. In general, the more resources which can be made available, the more flexibility (the more "options") the emergency response is likely to have.

The controlling phase was characterised by the successful maintenance of the immediate and supplementary responses, and of the confidence of the people who were still evacuated. The first success was dependent on the Command Post structure which provided a reference point for all those agencies that became semi-autonomous response agencies, on-site. The second success was dependant on the well organised police-media relationship, and on the successful initial evacuation. It was most dependent, however, on the clearly understood policy that the evaluation and resolution of the problem by the Control Group and the technical teams, had not only to be done, but had to be seen to be done.

As the week progressed, this last concern - the maintenance confidence - became of equivalent importance to the evaluation of the risk, since a lack of belief in the former would have rapidly translated into a lack of belief in the latter. Successively closer examination of the risks and proposed solutions resulted in new configurations of the organisations involved; but, as at the outset, these built upon the successful deployment of the immediate response agencies at the beginning of the week.

Ultimately, this success and the continuing success of the organisational response during the week was due to a fortunate series of circumstances. It is certainly the case that an alteration in the initial conditions of the emergency could have radically changed the nature of the subsequent organisational response.

While the creation of scenarios is fraught with difficulties, one quite plausible "what if" is that if the chlorine car had ripped wide open during the derailment, the rolling forward of a cloud of chlorine would have rendered all immediate emergency response, except for a desperate midnight race through the streets ahead of the cloud, useless. Car traffic through the cloud would have been impossible. It is very likely that even at the edge of the cloud, with concentrations of 1 ppm, there would have been great confusion as people were faced with the effects of the gas, darkness, and traffic chaos.

Closer to the derailment site, estimates have suggested that the number of deaths within half an hour could have been in the thousands. As one expert remarked in an interview, the most difficult part of the emergency response would have been finding enough morgue space for the bodies.