Session B, Track 1:
Lessons Learned from Actual Events (Non-Chernobyl)

Wednesday, September 9, 1998
2:05 p.m. - 4:20 p.m.

Chair: Charles Willis, United States Nuclear Regulatory Commission

Experience Managing the Response to a Damaged Source at Goiânia - Brazil

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INTRODUCTION

The radiological accident

Probably on September 13th, 1987, a strong radioactive ^{137}Cs source (~51 TBq at the time of the accident) was removed from an abandoned building in Goiânia and ruptured by some individuals in a backyard. They aimed to sell the obtained lead from the shielding as scrap material. This source was formerly used by a radiotherapy clinic in a teletherapy (^{137}Cs) machine. After they dismantled the machine and ruptured the source capsule, the material with commercial value (lead and steel) was sold to a junkyard store. It was reported that they noticed a blue light in the dark coming from the ruptured capsule source. This light caused fascination in several persons that came to see it. Small parts of the source were given to friends and relatives, causing external irradiation and internal and external contamination. Due to the constitution of the source (cesium chloride salt), it was highly soluble and easily dispersible in the environment by resuspension of the deposited material. The contamination was spread out over the city. This accident caused 4 casualties and at least 28 people injured with radiation burns The symptoms of the injured people were not initially recognized as radiation syndrome. A few days later, one person established a relationship between the source and the symptoms presented by the people and took the remaining material to the local health authorities. This action led to the discovery of the accident. A local physicist was called and he assessed the scale of the accident, evacuating two areas. The Brazilian Nuclear Energy National Commission - CNEN was informed and dispatched a team to the city in the same day.

DISCUSSION

CNEN arrangements for emergency response

The response of CNEN to radiological emergencies in the non-nuclear power sector ensures that there is a central person to contact, who is able to arrange the appropriate assistance. The head of the Department of Nuclear Installations (DIN) was in charge of coordinating the response in these events.

There was also an emergency plan for nuclear facilities. In this case, several groups were involved and have their own structure to respond. At least, a few people of each group were kept in standby to provide initial actions and activate the emergency response centers. During emergency situations the decisions would be taken by a joint coordination committee formed by major Government agencies such as CNEN, Federal, State and Local Authorities and from the utility CNEN has, in the plan, its executive group to coordinate all the actions of the response, a technical group to assist in decision making, two groups for plant safety evaluation, the field emergency monitoring and evaluation group of the Institute of Radiation Protection and Dosimetry and the administrative and logistical support group.

The initial response

CNEN headquarter was contacted through the head of DIN on September 29th, 1987 at 18:00 in Rio de Janeiro, soon after he arrived at Goiânia with two more technicians from São Paulo. They arrived at Goiânia at 00:30 of September 30th. This team first went to the abandoned building where the source was and after a survey, finding no radioactive source or trace of radioactivity, they went to the local health authorities building and found the leftover of the source. The dose rates at 1m from the source was 0.4 Sv.h-1 indicating that about 10% of the source was still there.

The CNEN team and the local physicist proceeded to the other identified sites and confirmed the initial surveys The dose rate value of 2.5 Sv.h-1 used to evacuate an area by the physicist and local authorities was based on simple criterion of the occupational limits, knowing that for the public the limit used to be ten times lower. The CNEN team, taking into account political aspects, decided not to change this value.

At 03:00 the CNEN Coordinator evaluated the situation as critical and demanded additional resources from CNEN headquarter. On that morning, the team dealt with the leftover source, which was over a chair. The team decided to bury it in a sewer pipe filled with concrete. This simple action reduced s significantly the dose rate.

At 06:30, another team from CNEN arrived with one physician and two physicists and start dealing with the contaminated or injured persons. A soccer stadium was designated as a temporary screening area where those persons were send. A physician from Tropical Diseases Hospital - first to recognize the possibility of radiation overexposure - had been overnight at the stadium. 22 persons were identified with symptoms of radiation exposure and sent to that hospital. By the end of the day, the two physicians, with the support of the physicists, had examined about 60 contaminated persons and took the first actions to decontaminate them.

The evolution of the response team

At 17:00 of September 29th, the Director of IRD was contacted and asked to prepare a team to send to Goiânia. Composed by the former IRD director, two physicians and health physicist support staff, this team arrived at Goiânia at 16:00 of September 30th. The former director acted as deputy emergency coordinator. The team faced a crowd of people in the stadium, including the press, which was looking for information, wondering if they were or not contaminated as they had been alarmed by the isolation of areas around the city.

The stadium was now designated as the place where people should go to be screened. In total, till the end of response, 112 000 persons were monitored and 249 found with detectable contamination.

The CNEN team established a headquarters at the State Health Authority facility. One main goal of this team was to conduct a well-documented survey of the contamination levels for planning purposes. All the main foci of contamination were found and isolated.

In the following days, more technical staff arrived at Goiânia. At this point, with the need for record keeping and logistical support for the response team indicated the need of an administrative staff.

The response team was divided into subgroups. Four of them to deal with cleanup of the most contaminated areas (Junkyard I, II and III, the house where the source was ruptured and others). One team was involved in the screening of persons at the stadium. There was also a specialized team for chemical decontamination of small areas, vehicles, personal belongings and small objects. The administrative staff was increased and subdivided in maintenance of equipment, logistic (laundry, material, finance etc) and administrative issues.

At this time a great volume of radioactive waste started being generated and a group was created to plan and develop the managing of that waste. This was one of the major logistical problems. There were no suitable assembles in the market, Brazil did not have a disposal site and there were only a few trained persons in this field.

The other resources

The need for ensuring that the control over the accident was gained, demanded additional aerial and terrestrial monitoring to be performed. The aerial survey found another important site contaminated in a sanitary waste deposit. The road network of the city was monitored with a vehicle equipped with a large detector of NaI(Tl) and GM probes for low and high dose rates. This survey found several spots of contamination of minor importance. Teams for either physical or chemical decontamination were settled for dealing with these small spots of contamination.

A whole body counter was designed and mounted at the State Hospital. A complete infrastructure at the hospital was settled, including heath physicist staff and decontamination room. An entire infirmary was reserved to the care of injured and contaminated internally or externally persons.

An environmental assessment group designed and executed a monitoring program performing more than 1300 measurements of 137CS in soil, vegetables, water and air. A small radiometry laboratory was built in Goiânia with sample preparation support. This group was also responsible for the decontamination of yards. The resuspension and dispersion of cesium was the major path of contamination of the environment. Based on a critical group dose bellow 5mSv, several remedial actions levels were derived, e.g., decontamination of property, restriction of home grown produce and removal of contaminated soil.

The long term phase

Some of the activities enter in a steady state. Most of the groups were well organized. Three medical care centers were working for different levels of radiation injury severity. Two of them were in Goiânia and the other, for the high severity injured people in Rio de Janeiro. Planning and beginning of decontamination processes were being carried out by the groups As might been expected, adverse reactions to matters related to radiation arouse from the public, some authorities and press. The choice of the site for the radioactive waste deposit was not only a technical decision but also a political concern. There were legal aspects to be taken into consideration. Finally the State Governor accepted a site 20-km away from the city.

As the deposit was crucial for the decontamination of the major foci, and the logistical and political difficulties tended to increase, a decision from the President of CNEN was taken. He decided to move his office to Goiânia and lead directly the CNEN task force and put large amount of resources in managing the situation. This action not only reduced the steps in decision making processes but, as well, compromised the CNEN headquarters and its Institutes, providing total support for logistic, analytical and dosimetry services as needed. The date of December 21st was established for the end of the decontamination of the main areas. The construction of the waste deposit was accelerated and, by mid of November, the removal and transport of waste started. Before this, the decontamination actions were restricted to preparation and prevention from deteriorating of the situation.

The total staff involved increasing up to 250 professional or technical staff plus 300 other staff for supporting the decontamination, transport and disposal of the waste, plus all the other activities. The date of December 21st was achieved with an effort of a 12-hours working shift.

CONCLUSION

The lessons we should learn and practice

- Radiological accidents become worse as time of discovery elapses.
- Records of radioactive sealed sources should contain information on physical and chemical properties.
- A general public information system should be set up on radiation matters.
- A social and psychological support should be provided for either the persons affected by the accident and the response team.
- International assistance depends on the local infrastructure. Emergency training and courses should be provided for this kind of accidents.
- Mobile system of first aid by air should be available.
- Equipment should be suitable for working in field adverse conditions.
- Records of available personnel resources in each area of interest should be kept.

- Temporary storage facility near the accident area is to be considered essential.
- Decision making and organization hierarchy should be well defined.
- Inspection programs are important and should be connected with an effective enforcement system

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Operation Morning Light:
Recovery of Debris from Cosmos 954

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INTRODUCTION

Cosmos 954 was launched on 18 September 1997, carrying an estimated 100 kilowatt (thermal) nuclear reactor. Such a high power level was necessitated by the fact that Soviet ocean-reconnaissance satellites of the time employed active radar as the remote-sensing technology. The satellite was estimated to have a mass of 4,000 kilograms, 50 kilograms of which was attributed to the U^{235} core. The reactor was taken to criticality shortly thereafter, but the satellite never functioned properly. Attempts were subsequently made to separate the satellite into three modules; two of which were expected to burnup on re-entry to the earth's atmosphere, while the core itself was to be boosted to a much higher orbit, allowing sufficient time for adequate radioactive decay before subsequent re-entry. All such attempts ultimately proved futile. Additionally, in early January 1998, attitude control of the satellite was lost and it began to tumble uncontrollably, thus greatly shortening it's space-borne lifetime.

The projected impact date at that time was 23 January 1978, somewhere on the earth's surface between 65^0 North latitude and 65^0 South latitude. The reactor core was anticipated to contain some 100,000 Curies of activity, mostly due to the isotopes Cs^{137}, Sr^{90}, Ce^{144}, Zr^{95} and Np^{239}, given its burnup history. On 22 January 1978 various nuclear emergency assets in Canada and the United States were put on a two-hour notice, through the NORAD agreement.

Actual re-entry occurred at 0353 (Pacific Standard Time) over Great Slave Lake, in Canada's North West Territories. Debris was expected on the ground along the satellite's final track from Yellowknife to Baker Lake, a distance of some 500 nautical miles, in a direction of 062^0 True. A few (mostly inebriated) eyewitnesses observed the re-entry visually from the city of Yellowknife. Thus in the early morning of 24 January 1978, "Operation Morning Light" (a randomly-selected code name) and the world's first (only?) predicable nuclear emergency began.

DISCUSSION

Operation Morning Light was, from its beginning, a joint operation between Canada and the United States of America, including assets drawn from the Canadian Department of National Defense, Department of Energy, Mines and Resources, the Atomic Energy Control Board and the American Department of Energy. The Canadian Forces Base at Edmonton, Alberta was activated to conduct the operation. A Canadian Nuclear Accident Support Team (22 personnel) was deployed to Yellowknife and at 1630 PST two American C-141 Starlifters arrived from Andrews Air Force Base, carrying the DOE's Nuclear Emergency Search Team and their equipment. Approximately six hours later, at 0015 PST 25 January, the first search mission was initiated; a Canadian C-130 Hercules aircraft carrying US radiation detection equipment. This consisted of an array of twenty-eight 4" x 4" Sodium-Iodide scintillators. Five gamma-ray spectra were obtained per second as the aircraft flew at an altitude of 1000' above ground along the satellite's estimated re-entry track (Figure 1).

Later that same day additional assets from both the USA and Canada arrived at Edmonton and an additional search team was deployed to Baker Lake, at the terminus of the re-entry track. By the end of the day a total of twelve aircraft were involved in the search (4 Hercules, 3 Twin Otters, 1 Convair (US) and 4 helicopters) carrying four NaI detector arrays (three American and one Canadian, provided by the Geological Survey of Canada). Search missions conducted that day involved three Hercules flying in formation (½ mile apart) at 1000' along the satellite's re-entry track, and on both sides of it.

The following day (26 January) at 1900 PST the first radioactive anomaly ("hit") was detected, at the northeastern end of Great Slave Lake. A ten-mile square grid at ½ mile spacing was then established around this point and searched by a second aircraft. No additional hits were detected, but the original one was confirmed. Airborne infrared search missions were also flown over the entire search area, being completed the following day, with no anomalies reported.

On 28 January a large piece of non-radioactive debris was found by chance by two of six persons engaged in a fifteen-month dog-sled expedition across Canada's northern wilderness, recreating the 1926/7 journey of an English explorer, John Hornsby. The debris was found in the Warden's Grove area within the Thelon Game Sanctuary. Additionally, that same day three more radioactive anomalies were located in the McLoed Bay area, two of which were confirmed to be satellite debris and one a natural outcropping of Thorium.

Around this time the search was becoming much better organized (Figure 2) with specific responsibilities and lines of communication allocated to individual elements In addition, the search area itself was much more methodically defined and prioritized. From theoretical calculations of re-entry and atmospheric observations at the time, a wind-corrected debris track was estimated. Winds aloft blew from the North at the time of re-entry, thus it was expected that smaller and lighter objects would be found widely dispersed south of Great Slave Lake, while higher Beta (i e , mass-to-drag ratio) objects would be found further down-range and closer to the actual re-entry track. (This was eventually confirmed.) It was also expected that some objects with a Beta of up to 300 lbs/ft^2 would be found closer to Baker Lake, although as it eventually transpired, none of that size was ever found.

However, objects of lower Beta were being found in the Thelon River area, near Warden's Grove, and a decision was made to relocate the recovery team at Baker Lake to what eventually became known (as it is to this day) as Cosmos Lake, in the Thelon Game Sanctuary. This relocation commenced on 29 January 1978.

By the end of January many more fragments had been identified and located, most radioactively but some not - these had been observed visually during airborne searches. Also around this time a concept of search operations began to evolve Instrumented C-130 aircraft, operating out of Edmonton, systematically flew parallel track lines at 1000' AGL, in each search sector. Hit co-ordinates were then passed to recovery teams based in Yellowknife and Cosmos Lake. An instrumented helicopter would then be flown to these co-ordinates to further localize the hit. This flight would not land, for fear of contamination which might render the aircraft useless for further operations. Instead it would drop brightly-coloured markers to locate the hit. A second helicopter mission would then be flown to extract the debris from the ice, since most melted into it, and to assess the extent of the radiological hazard. If practicable, the debris would be recovered at this time. If it were too bulky or too radioactive for standard shielding containers, a special container would be fabricated at the University of Edmonton and then shipped to the field on one of the daily re-supply flights. Another helicopter mission would then recover the object for subsequent shipment to, and analysis at, the Whiteshell Nuclear Research Establishment, in Manitoba. A final, instrumented, helicopter mission would then be flown to the same site, to ensure that the recovered fragment had not masked other debris of lesser activity.

On 1 February the most radioactive fragment found to date was located, measuring some 200 R/hr near contact. This was thought to be a structural element of the reactor core, with some spent fuel condensed on its exterior.

Operations continued until the end of March 1998. By that time a total of 608 airborne search missions had been flown. Numerous large objects had been found along the track between Artillery Lake and Cosmos Lake, including six Beryllium cylinders (about 3" in diameter and 8" long), all virtually intact, and many more Beryllium pencils of much smaller size.

Additionally, literally thousands of small particles of spent fuel were discovered from Great Slave Lake south to the Alberta border. These were typically about 200 microns in diameter and were dispersed unevenly over an area of some 20,000 square miles. Individual particles were retrieved if they emitted in excess of 100 microR/hr at one metre, or if they were found in populated areas (e.g., the towns of Snowdrift and Fort Reliance), since in Winter the local Innuit melt surface snow as a source of potable water.

On 28 February a small piece of spent fuel was recovered, comprising about one cubic centimetre, and emitting over 500 R/hr near contact - this constituted the most radioactive fragment found during the entire search.

CONCLUSION

Approximately 100 objects were ultimately recovered, constituting some one percent of the estimated radioactive inventory. The remainder was concluded to have been spent fuel which had vaporized upon re-entry and eventually settled over a very large area surrounding the search area, and perhaps worldwide. There is a high level of confidence that all major pieces of debris were located and retrieved, many of which consisted of Beryllium metal - thought to be part of the reactor's combined reflector and criticality control system.

LESSONS LEARNED

There were four major lessons learned from Operation Morning Light, two of which remain valid today and two of which have since been superceded by the intervening twenty years.

Firstly, many NaI crystals were lost due to cracking in the extremely cold weather. These must be protected by sufficient insulation to limit their rate of thermal change to less than about 2^0 Celsius per hour.

Secondly, in adverse environments such as Canada's North, it required three times as many personnel as would have been required in more moderate climates to do the same amount of work, due to fatigue and the loss of manual dexterity to bulky survival clothing.

Thirdly, at the time a bottleneck developed in computational capability. It took four hours to analyze the data from one hour's worth of flight time, using the PDP 8/e's and PDP 11's of the period. This should not be a problem today.

Finally, navigational repeatability was a major problem early in the search, when trying to relocate debris which had been previously identified. A microwave ranging system was deployed as a solution, but at considerable cost and inconvenience in relocating the beacons and changing their batteries daily. Today, inexpensive ($100) hand-held GPS receivers would easily solve this problem, given their typical 10-metre precision.

One other lesson was also learned, of particular relevance to Canadians. When operating in an environment where the daytime high sometimes reaches forty degrees below zero, be sure to bring along a heated toilet seat!

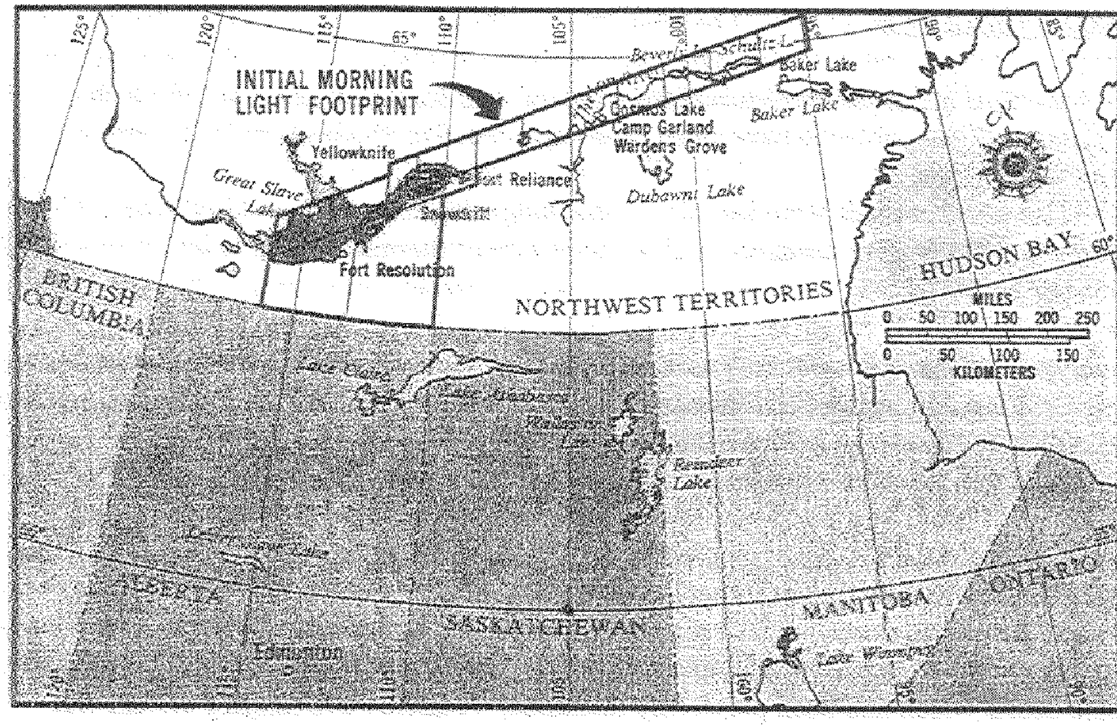

Figure 1: Cosmos 954 Search Area.

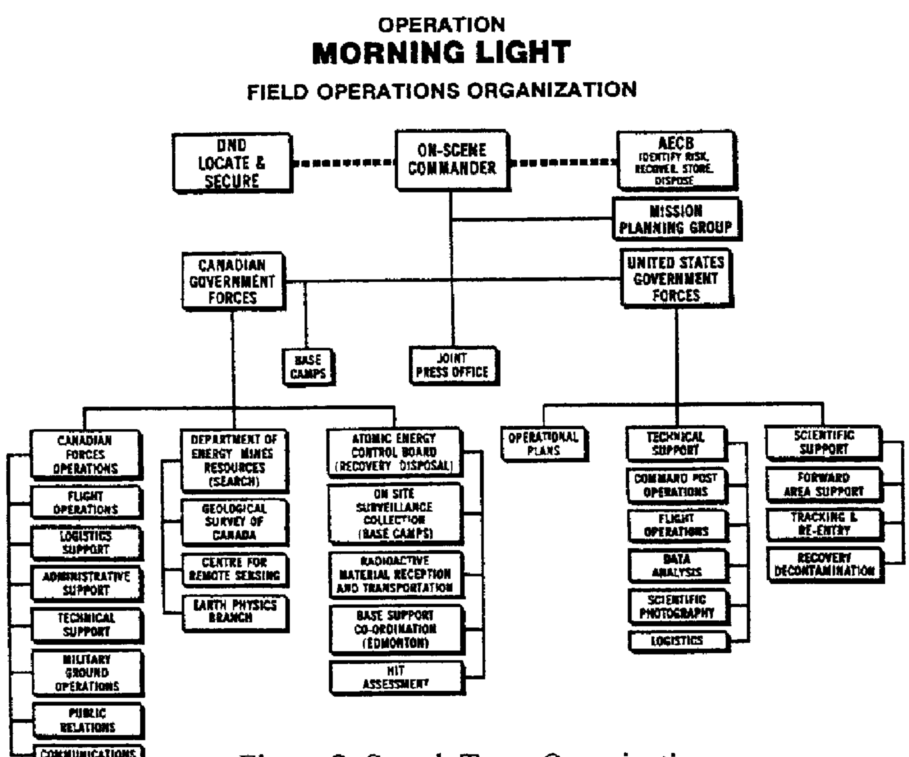

Figure 2: Search Team Organization

Post-Emergency Management Issues Following Inadvertent Melting of Radioactive Sources

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INTRODUCTION

Steel manufacturers are encountering radioactive sealed sources in incoming scrap metal inventories that are, on occasion, not detected, even though monitoring and detection instrumentation is being used. Unfortunately, they end up being melted in the mill's furnace, resulting in the emissions control system and supporting facilities being contaminated with radioactive materials. This paper briefly describes a recent incident where a facility was contaminated by such an event. The remediation and resulting facility recovery, though successful, is often not the event that has the greatest impact on facility operations and financial resources. It is the post-emergency activities that have a greater impact on the steel manufacturer involved in such an event It often results in facility alterations to operations because of the generated radioactive wastes that remain onsite following completion of remedial activities. The impact on operations and financial resources are described below.

DISCUSSION

In April of 1997, a steel manufacturer located in Kentucky experienced a radioactive source melt event in which a radioactive cesium-137 (Cs^{137}) source, in an unidentified form, was inadvertently melted. The sources vaporized during the smelting process in the electric arc furnace (EAF) which resulted in contamination of the emissions control system and EAF dust handling equipment. The emission control system consists of the entire inside of the baghouse, the EAF dust conveyor system including portions of the railcar filling area, the main ventilation duct and associated components from the melt shop. The event was discovered when a railcar containing EAF dust was sent to an offsite processing facility where it set off the facility's fixed railcar radiation monitor. Upon detection, the Commonwealth of Kentucky, Department of Health, was notified and all operations at the steel mill were ordered to be terminated. The remediation contractor responded within 24 hours upon the steel mill's request to assess the extent of contamination. A contract was provided to the remediation contractor for decontamination and survey work scope to return the mill to operational status. The contractor assessed the extent of the radioactive contamination, provided onsite remediation support, and developed the work plans for decontamination of the facility. The remediation contractor used a combination of decontamination techniques to accomplish the guidelines established by the Commonwealth of Kentucky to remove the radioactive contamination and return the facility to unrestricted use. The efforts of the contractor enabled the steel mill to commence operations within 12 days after the incident. The contractor received a bonus payment from the customer's insurance company for completing remediation ahead of schedule, allowing the company to resume steel-making operations, and minimize the insurance company's liability. In addition, the contractor enabled the company to comply with the guidelines for unconditional release of land areas, slag, and EAF dust from the Cs^{137} contamination incident. Currently the contractor is conducting periodic sampling activities of the emissions (EAF dust) to insure compliance with the requirements of the Commonwealth of Kentucky and Department for Public Health with additional survey activity for metal scrap survey oversight.

After the remediation was completed and resumption of plant operations the company was left with two new management variables that they previously did not have to deal with operationally or financially. The first was the establishment of a controlled area with restricted access for the storage of the radioactively contaminated materials generated from the remediation. The second is the financial burden of the management efforts and waste disposal costs incurred as part of the incident. The company was left with a considerable quantity of mixed waste (radioactive and hazardous materials) that require special handling. Instead of being able to send the EAF dust on to a recycle center for recovery of certain useful metals, the steel mill is faced with disposal at a specially licensed burial site. Other debris, which could generally go to unrestricted commercial or industrial landfills, must also be disposed of at a licensed burial site. To further complicate matters the radioactively contaminated EAF dust and other production residues are considered a mixed waste because of the presence of the radioactive component and the presence of hazardous component heavy metals. This escalates the cost of disposal because of the mixed waste category for the dust and other debris.

For most companies, the final disposal of the waste often lags behind the remediation. There are several reasons for this occurrence. First of all, companies are unfamiliar with the requirements for restricted disposal options. There is a learning period during which company representatives become acquainted with requirements which have not previously been dealt with, which are different from the usual disposal environment with which they are familiar. The second reason is the complexity of disposal site criteria. This usually includes characterization and waste stabilization activities that companies are generally not knowledgeable concerning waste preparation for disposal. Thirdly, companies are not set up for waste processing for stabilization and shipment. They have neither the equipment, procedures or regulatory licenses/permits to perform such activities. This usually necessitates going to an outside service supplier to perform these operations for the company which results in an added expense over and above the waste disposal costs. Finally, waste disposal is usually delayed because of the expense of disposal itself. As a general rule, the cost of disposal for these generated wastes are higher than the cost of remediating the facility equipment, systems and structures. In the cited case in this paper the cost of the remediation was slightly greater than $1 million while the cost of waste dispositioning (stabilization, packaging and disposal) was higher.

The generation of radioactive wastes during remediation activities requires companies to set up controlled, restricted areas for the purposes of radiation protection and contamination control.

This means giving up site space and/or facilities that may normally be dedicated to routine site operations. This may require re-engineering of site activities to accommodate the interim storage of the radioactive wastes. Depending on the planned time for onsite storage, regulatory authorities will require a company to obtain a radioactive material license authorizing the possession and storage of the radioactive waste. This obviously adds a new administrative burden which the company has not encountered before. The company must now expend resources for posting and maintaining a restricted area. This involves setting up an organization with designated duties and responsibilities, posting the area with "Caution-Radiation Area," and "Caution-Radioactive Material" signs, developing and conducting a training program for designated radiation workers, assigning personnel dosimetry, and implementing site access control and surveillance programs, in short, setting up a radiation protection program.

The expense of waste disposal represents a financial challenge to the company if the unplanned funding must come from internal resources. Funding mechanisms need to be identified within the company if insurance coverage was not available at the time of the incident. It is interesting to note that some insurance companies have bulked at paying coverage claims in cases where a company incident is a second event of the same kind. One current client is experiencing such a response from its insurance carrier which subsequently has escalated into litigation.

Returning the site to normal conditions requires the intervention of State regulators from both the Division of Solid Waste Management and the Division of Radiological Health. This becomes costly to the company as a post emergency measure. These agencies require the company to show proof that the materials have been removed, or are properly containerized for short or long term storage. Showing proof that the materials have been removed is a costly expense as it requires several types of surveys to be performed by a qualified vendor. Typically, the regulators have specific criteria that the site must meet to be released for unrestricted use. Storage of these materials includes compliance with the requirements for hazardous/radioactive container inspections The Division of Solid Waste typically requires a weekly container inspection and the Division of Radiological Health typically requires surveillance on a similar frequency. Additionally, both agencies require the responsible individuals to have appropriate initial training with refresher courses at some frequency.

Once a company has completed all activities associated with an inadvertent melting of a radioactive sealed source, serious attention must be given to minimize the recurrence of a subsequent event. The company should review its operations and install monitoring/surveillance systems at strategic points. The company must understand the strengths and weaknesses of any monitoring system including radiation detector sensitivity, scan speeds, and therefore, vehicular speeds in monitoring incoming inventory. The maintenance of the detection system is important since it is often operated in harsh environmental conditions. The investigation of a system alarm is important so that the operator(s) can become familiar with operational characteristics of their monitoring system, this being able to differentiate between positive indicators and false positive alarms. It is inherent that a company understand that even under the best circumstances and ideal conditions, a radioactive source may go undetected.

CONCLUSION

Steel manufacturers who have successfully remediated their facilities are faced with a greater challenge in the post emergency phase because of the complexities of waste management associated with facility remediation. Steel manufactures are typically not experienced in handling radioactive waste and often do not have the financial resources to deal with the waste management consequences. It is recommended that a steel manufacturer consider preparing an emergency plan that covers termination of operations in the event of a radioactive source melting incident. It should contain points of contact for governing regulatory authorities as well as describing area isolation instructions for the establishment of restricted areas, clean up procedures and instructions and criteria for returning the facility to normal operations. Waste management and disposal issues should be generally described with available options. The plan should be periodically reviewed and updated for applicability and incorporate any regulatory changes that will impact these activities. While it is not required, the steel manufacturer should meet with the appropriate regulatory agencies to learn before hand the expectations of those offices should an event occur. This proactive posture by the steel manufacturer will help minimize mistakes during any subsequent cleanup.