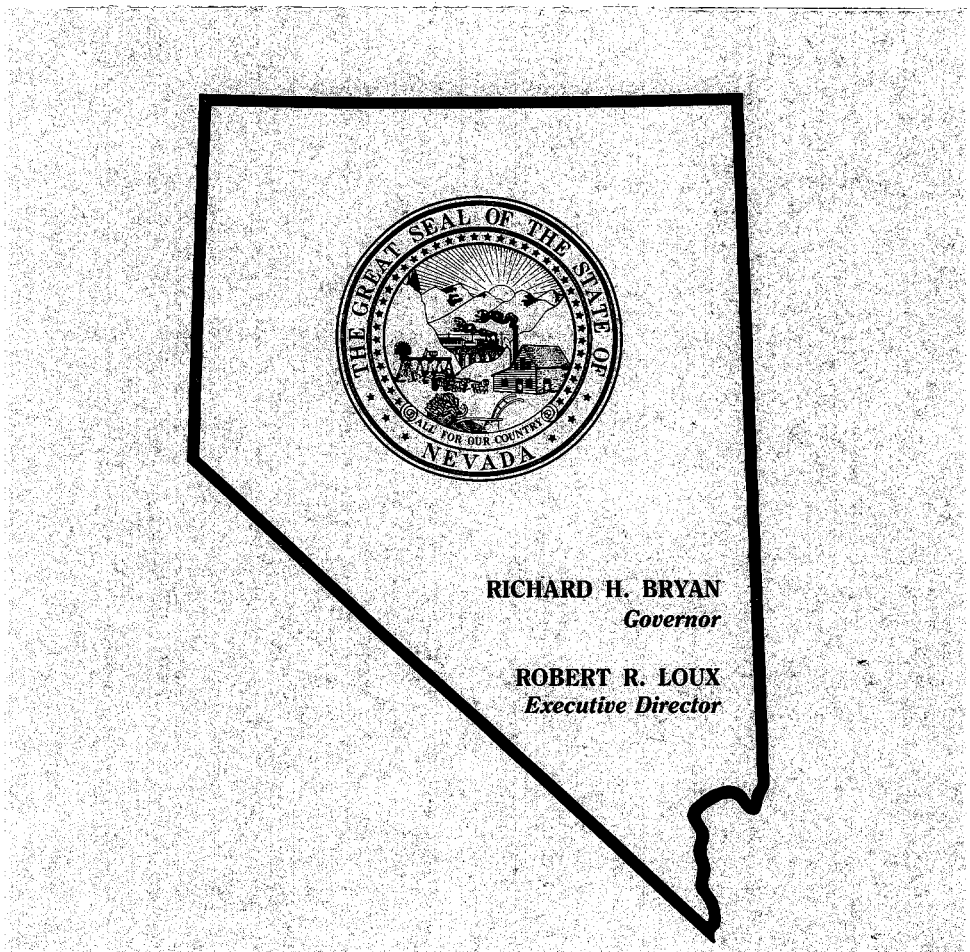
STATE OF NEVADA

AGENCY FOR NUCLEAR PROJECTS/ NUCLEAR WASTE PROJECT OFFICE



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GOIANIA INCIDENT
CASE STUDY

by

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The Nevada Agency for Nuclear Projects/Nuclear Waste Project Office was created by the Nevada Legislature to oversee federal high-level nuclear waste activities in the state. Since 1985, it has dealt largely with the U.S. Department of Energy's siting of a high-level nuclear waste repository at Yucca Mountain in southern Nevada. As part of its oversight role, NWPO has contracted for studies designed to assess the socioeconomic implications of a repository and of repository-related activities.

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FOLLOW-UP STUDY OF GOIANIA INCIDENT

This report on the Goiania Case Study is submitted in fulfillment of our subcontract with the Yucca Mountain Socioeconomic Study being carried out by Mountain West (MW), the prime contractor, in accordance with the scope of work described in the Task Work Order Authorization for MW Activity No. 22 (Revised), Task 7.5: Hazardous Events Case Study.

INTRODUCTION

The reasons for wanting to document this case study and present the findings are simple. According to USDOE technical risk assessments (and our own initial work on the Hanford socioeconomic study), the likelihood of a major accident involving exposure to radioactive materials in the process of site characterization, construction, operation, and closure of a high-level waste repository is extremely remote. Most would agree, however, that there is a relatively high probability that a minor accident involving radiological contamination will occur sometime during the lifetime of the repository -- for example, during transport, at an MRS site, or at the permanent site itself during repackaging and deposition. Thus, one of the major concerns of the Yucca Mountain Socioeconomic Study is the potential impact of a relatively minor radiation-related accident. A large number of potential accident scenarios have been under consideration (such as a transportation or other surface accident which results in a significant decline in tourism, the number of conventions, or the selection of Nevada as a retirement residence). The results of the work in Goiania make it clear, however, that such a significant shift in established social patterns and trends is not likely to occur as a direct outcome of a single nuclear-related accident (even, perhaps, a relatively major one), but, rather, are likely to occur as a result of the enduring social interpretations of such an accident -- that is, as a result of the process of understanding, communicating, and socially sustaining a particular set of associations with respect to the initial incident.

Many of the accident scenarios under consideration for the Yucca Mountain site involve the release (or the potential release) of a relatively small amount of radiation to the environment. In any such scenario, the radiation exposure itself is an obvious problem

both in terms of physical risk and in terms of the socioeconomic impacts on the exposed persons and communities.

However, it has been postulated that the social, political, and economic impacts of the exposure are relatively minor when compared with the socioeconomic consequences of people's perceptions of the risks involved. Thus, the key objective in assessing the impacts likely to result from a nuclear-related accident, is to establish the concrete linkage between perceptions of the risk involved, initial behavioral response, and enduring social interpretations of the event.

The radiological accident that occurred in Goiania, Brazil in September 1987 provided a unique opportunity to gather data that could be used to test the accuracy of the perceived risk postulation. Upon becoming aware of the Goiania incident, which is described later under "Background" on page 2 of this report, Impact Assessment, Inc. (IAI) of La Jolla, California mounted a self-funded initial research effort headed by Dr. John S. Petterson, IAI President. The initial field investigation was undertaken within a week of the time of the first account of the incident was published in the United States press. Departing on November 14, 1987, Dr. Petterson spent nine days conducting interviews and collecting published and unpublished information about the incident. These initial data were analyzed and presented in a paper to the Waste Management '88 conference held in Tucson, Arizona in early March, 1988 (a copy of which was provided to the Nevada Office of Nuclear Waste Management). The follow-up study, reported here for the first time, was partially funded by the State of Nevada as an element of Task 7.5: Hazardous Events Case Study. Fieldwork was conducted between April 6, 1988 and May 5, 1988 and write-up was completed over the period of May 5, 1988 to June 5, 1988.

The Goiania event continues to provide a unique opportunity to examine how a relatively minor accident involving radioactive material could result in a chain of events affecting an entire state's economy, stigmatize an entire state's population, and disrupt social relations throughout a community, state, region, and nation. It is a classic example of the process by which the public perception of risks, not the actual event or risk itself, can result in a wide array of painful and costly responses.

Based on the analysis of the data obtained during the first visit to Brazil, the working hypothesis was that the social, economic, psychological, political, and legal impacts of the

Goiania incident would show a very rapid peak in October and November, begin to decline gradually in December, fall off dramatically by January or February, and be largely extinguished by March. Thus, the intent of the follow-up visit was to collect sufficient supportive documentation to clearly identify the early impacts, their sources, and ultimate costs, and to assess the process of re-adaptation to a post-accident social environment -- i.e., the medium-term impacts. The key question in need of an answer was how fast, and in what form, the community, the state, and the nation have recovered from the incident. Unexpectedly, however, the second data collection phase resulted more in an examination of the continuing course of on-going impacts than in a postmortem study of early consequences.

This report necessarily begins with a brief summary *background*, describing the Goiania incident; followed by a description of the *objectives* of this follow-up study; a description of the specific *plan of work* that was undertaken; and the *results* of the study.

BACKGROUND

On September 13, 1987, two metal and paper scavengers of the city of Goiania (pop. 1,000,000), in the central Brazilian state of Goias (pop. 13,000,000) entered an abandoned clinic in search of scrap metal.[1] They discovered a 400 kilogram machine that had been used to treat cancer patients with controlled doses of radiation. They dismantled the device and extracted a stainless-steel cylinder, after which they took this cylinder to a junkyard, broke it open with a sledge hammer, and removed a one- cubic-inch platinum capsule. Subsequently, they sawed opened the capsule, revealing approximately 100 grams[2] of luminescent material, which was described by witnesses as "carnival glitter."

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[1] During field research, this facility (the Goiania Radiotherapy Institute) was visited just after the accident (i.e., in November, 1987). At that time, the building was almost totally demolished with only portions of the brick walls left standing. Judging by the accumulation of weeds, human excrement, trash and other debris scattered throughout the facility, it was clear the building had been open to public access at least a major portion of the two-year period following abandonment.

[2] When fabricated in Italy in 1971, the capsule contained 91 grams of material, consisting of 28 grams of cesium chloride and 63 grams of a binding agent. This material represented approximately 2,000 curies in 1971 and, assuming a 30-year half-life, approximately 1,375 curies today as the cesium continues to decay into barium.

Children playing in the junkyard were attracted to this glowing, "magical", material and began to play with it -- spreading it on their hands and bodies. The children and the workers, in turn, took it home with them, showed their friends, and spread it on clothing, paper, walls, floors, and, in the case of a six-year-old child, even consumed some of the material that had spread from her hands to her food. In this last case, the child began to vomit after just ten minutes. Within a few days, many others would fall ill. It would be nearly two weeks, however, before their illnesses were diagnosed as radiation poisoning, and the source of the problem, cesium-137 exposure, was identified.

On October 22, 1987, 39 days after the cesium-137 material was released from the capsule, the six-year-old child died. Ultimately, three other individuals have died and one man has had an arm amputated. Several others have been treated for external lesions, a few of which have been quite serious and have involved repeated attempts at tissue grafting. But, perhaps most significant, are the secondary consequences that have occurred as a result of the public's reactions following the initial incident -- reactions resulting from the public's perception of their own risk of contamination.

OBJECTIVES

The overall objective of the study of the Goiania event is to clarify the *processes* by which perceived risks and concerns are channelled into actual impacts. The specific objectives of this follow-up study were:

(1) To demonstrate the universal characteristics of the post-accident impacts and to counter the inevitable argument that perceived risk effects are somehow culturally defined;

(2) To specify the medium-term physical consequences of the accident;

(3) To track the course of medium-term economic impacts;

(4) To describe the medium-term social ramifications;

(5) To assess the medium-term political consequences; and

(6) To characterize the local, state, and national measures that were taken by Brazilian institutions to mitigate these impacts.

PLAN OF WORK

With the forgoing six objectives in mind, the plan of work for this follow-up investigation was structured as follows:

(1) Review the existing primary and secondary data collected in Brazil in November 1987 to identify time-critical components for monitoring the elements in the six objectives discussed above;

(2) Conduct a three- to four-week revisit with key informants in Rio de Janeiro, Brasilia, Sao Paulo, and Goiania to provide additional quantitative and qualitative support for initial findings and to develop additional issues not identified or adequately addressed in the original research; and

(3) Prepare a summary report on findings indicating potential key areas where additional information or documentation will be required to develop a full- scale case study.

RESULTS

Introduction

Prior to departing for Brazil on April 6, 1988, the initial field notes were carefully reviewed to identify key issues and the secondary materials were reorganized to focus on the six objectives of the second field data collection effort. The primary purpose in this review was to assure that the key data gaps were clearly identified and to avoid redundant field data collection.

As one of the key objectives was to determine how the federal government responded to the problem, the work began in Brasilia, the capital of Brazil. This city was designed specifically to house the government's ministries, making it perhaps the easiest capital in the world to find a specific office or official. Thus, Dr. Petterson was sometimes able to meet key representatives and obtain critical documents from several sources or even from multiple agencies (e.g., Health, Labor, Justice) in a single day.

On April 14, 1988, Dr. Petterson traveled from Brasilia to Goiania, where he followed a very tight agenda intended to: (1) recontact all of his original informants; (2) methodically expand his network of contacts in the community; and (3) collect all pertinent documents that had been produced since the accident.[3]

Work in Rio de Janeiro began on April 19, 1988 and focussed on the role of the National Nuclear Energy Commission (CNEN). Interviews were conducted and documentation obtained from the staff psychologists, licensing authorities, department heads, and other decision makers who played important roles in determining: (1) how the victims were treated; (2) cleanup priorities; (3) disposition of the wastes; (4) distribution of social services; (5) compensation criteria; and, (6) media relations. A day was also spent at the Institute for Radiology and Dosimetry (IRD) of CNEN in Barra de Tejuca, just to the south of Rio de Janeiro. This was the "front line" agency in responding to the accident. Individuals from this agency were responsible for determining the distribution of the cesium-137 throughout the community, for monitoring the contamination victims (and the 125,800 individuals who thought they might have been contaminated), and for actual cleanup of the contaminated sites. Interviews were conducted with the director, the public relations officer (who handled much of the early decision making in responding to the accident), the equipment and calibration manager (who maintained all of the technical equipment), and many of the individuals involved in logistics -- transportation, field equipment and supplies, food and lodging, etc. (a major problem area).

Dr. Petterson then spent two days in Sao Paulo collecting information on the role of the Institute for High Energy Nuclear Research (IPEN). This agency, in coordination with IRD, was responsible for providing many of the actual field staff (numbering as many as

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[3] It should be noted that the number of key informants did not increase significantly. This is not an insignificant observation. Any researcher who has worked in small communities will recognize that the number of "key" informants is extremely limited. This will be the case for any community, and almost any type of issue. Virtually anyone in a community will be able to identify the "leading" authority on any particular subject. What is important is that the individuals who would play critical roles in disseminating information, who will be sought out in the event of an accident, and who can and should be identified in advance in order to prepare them for such an eventuality.

500 during the height of activity) as well as a number of technical specialists involved in assessing waste collection and storage requirements.

Purely by coincidence, the Second International Conference on Nuclear Energy was scheduled to occur during April in Rio de Janeiro and involved not only a consideration of the role and problems of nuclear power in Third World countries, but was to include two days of sessions on the Chernobyl accident and two days of sessions on the Goiania accident (a copy of the agenda is attached as Appendix A). While this would ultimately result in an additional week of field time in Rio de Janeiro and delay Dr. Petterson's return home until May 5, 1988, there was no question of the importance of attending and participating in these sessions, and justified the decision to remain.

Fulfillment of Objectives

1. Role of Cultural Differences

The first objective, and one of the key underlying goals of this particular study, was to develop information that would convincingly and forcefully dispel the notion that the social and economic impacts of perceived risks are somehow culture-bound, and therefore, in some way, not applicable to the United States (in particular, to the Yucca Mountain site). That is, Dr. Petterson had already been confronted by a general attitude, particularly prominent among the so-called "hard science" researchers, that since the accident occurred in another country that it was not a good model for what might happen in the United States -- that the reaction of Brazilians would somehow be different from those of Americans faced with an identical accident. Thus, considerable time was devoted to retracing in detail the evolution of the event itself and to outlining the process by which the social and economic impacts of the event were disseminated in order to demonstrate parallels with the United States Who were the individuals who came into contact with the material? How was the fact of the contamination first uncovered? Who were the individuals that made the original determinations of contamination? On the basis of what information was the decision to call in CNEN and the State Health Agency made? When and by whom was this decision taken? What were the social mechanisms, and the formal and informal channels by which these impacts were

transmitted throughout the social and economic systems, and in what ways were these similar to or different from the United States?

There are, of course, social, educational, economic, and cultural differences which influence the potential severity of public reaction to an accident. That should not be the question. At issue is whether or not populations in the United States would be subject to the same kinds of reactions and whether or not these reactions would result in similar or related socioeconomic impacts.

Anticipating this issue, one of the original objectives in conducting the first field work in November, 1987 was to try to demonstrate the similarities between the two populations, i.e., how the two systems were analogous. For example, Brazilian doctors and dentists, trained in the United States, routinely refused to treat patients without certificates; unlike other emergencies, nurses refused to return from a labor strike to treat contaminated individuals; and politically and economically well-placed individuals sought preferential treatment (certificates) for special surveys of homes they wanted to buy or sell, as well as for special "in- house" monitoring. Public administrators, and even technical and nuclear specialists, also trained in the United States, were affected in the same way as the less educated and socioeconomically disadvantaged Goiania residents. Dealers and wholesalers of every imaginable product sought and received certificates of non-contamination. During the second visit, the intent was to collect additional support for this approach. However, even after collecting additional useful, interesting, and convincing anecdotal support for this contention, it was concluded that this kind of information would not, independently, convince skeptical readers.

Rather than argue "absence of cultural differences," perhaps the most useful approach is to simply demonstrate cultural similarities. That is, in what ways have communities in the United States reacted in similar ways to related kinds of events? The case that seems most applicable is the public panic that resulted from the famous Orson Welles "Martian invasion" broadcast. This is a particularly useful example because all of the social and psychological impacts resulted not from an actual "invasion" but purely as a result of beliefs about or perceptions of risk. Since this example is familiar to everyone, the specifics will not be recounted, but several of the key areas of comparison will be provided: (1) a very large portion of the population believed what they heard on the radio; (2) many individuals and families took concrete action to protect themselves from

risks they believed were real (including driving in a panic away from the perceived risk, hiding in their cellars, calling friends and relatives with warnings, etc.); (3) many people who had not heard the original broadcast were caught up in the panic through social lines of communication; and (4) even after the obvious absurdity of the "invasion" had been demonstrated, many individuals remained emotionally reluctant or unwilling to accept the fact that the event had not taken place.

The Goiania event provides a number of interesting parallels. In the first place, the actual outbreak of panic did not occur with the original discovery of the cesium contamination. The incident (which began with the removal of the capsule from the abandoned clinic on September 13, 1987) was, in fact, described in the Goiania newspapers as early as September 28, 1987, but it was not until October 1, 1987, after a lengthy, very emotional and exaggerated television broadcast by a television journalist in Sao Paulo, that a generalized panic began. Thus, the Goiania "incident" we are most interested in (i.e., that portion of the ensuing social and economic effects that must be attributed to "unwarranted" and enduring social interpretations of reality) can be said to have begun on October 1, 1987. The important thing to remember, however, is that neither the actual physical "accident" itself nor its media aftermaths were single events; rather, there were dozens of smaller events. What is of interest to us are the cumulative and interactive impacts of the entire range of events.

It is immediately after the Sao Paulo television broadcast that: (1) people began to leave the community; (2) a telephone "hot line" had to be established (to respond to nearly 1,400 telephone calls a day reporting possible contaminated sites, to obtain information on radiation monitoring, to request visits by the mobile decontamination unit, to seek medical help for believed contamination, etc.); and (3) political pressure to contain the spread of contamination accelerated.

2. Medium-Term Physical Consequences

The second objective was to assess the medium-term cumulative *physical* consequences of the accident. The basic question to be addressed here is: Purely from a technical perspective, what are the recognized and quantified physical consequences of the accident to date, as well as those anticipated for the immediate future?

As of April 18, 1988, there had been 249 suspected cases of contamination. Of these, 120 concerned shoes or other clothing only; the remaining 129 cases involved traces in skin, of which 79 were decontaminated and sent home with less than 0.1 nanocurie/sq. cm readings, 50 were hospitalized or placed in a temporary dispensary under medical care with greater than 0.1 nanocurie/sq. cm readings, of which 20 were, at one time or another, considered "serious". Four people have died, one individual had an arm amputated, and several major grafting operations have been, and remain to be, performed.

In the follow-up visit, it was learned that:

(1) All monitoring and cleanup activities had been discontinued.

(2) Conflict continues over acceptable levels of background contamination in Goiania, and what constitutes a "safe" level.

(3) Follow-on whole-body monitoring of internally contaminated victims, and some of the CNEN workers, is expected to continue for several years.

(4) No new deaths were recorded since the last visit.

(5) No new cases of radiation contamination were reported.

(6) No new amputations were reported.

(7) Of the 720 individuals involved in the decontamination process, only 17 (2.37%) were exposed to doses in excess of 10.0 mSv, while 585 (81.2%) received less than 2.0 mSv. The highest recorded exposure was 15.8 mSv. Full-body measurements of the individuals involved in the decontamination process showed that 133 (or 18.5%) had suffered some degree of internal contamination (though the maximum level detected corresponds to an equivalent dose of only 0.3 mSv in 50 years).

(8) Decontamination operations were essentially concluded on December 21, 1987, 82 days after notification). These activities involved: the decontamination of open areas; identification, destruction, and removal of contaminated buildings; removal of contaminated layers of soil; elimination of other critical pathways for the spread of contamination; removal of obstacles to the decontamination process; packaging of contaminated wastes in 1,219 large metal containers, 2,822 heavy duty 55 gallon drums, and 14 shipping containers (the size of a mobile home); and transportation of more than 3,000 cubic meters of waste to temporary storage site at Abadia de Goias, 20 kilometers from city limits. A total of over 100 tons of waste have been collected.

(9) Of the 129 individuals who showed some internal or external contamination, 45 showed committed equivalent doses of less than .005 Sv (70 years), 42 showed doses in the .005 to .05 Sv range, 33 showed doses in the .05 - 1.0 Sv range, 4 in

the 1.0 to 2.0 Sv range, 2 in the 2.0 - 3.0 Sv range, 1 in the 3.0 - 4.0 Sv range, 1 in the 5.0 - 6.0 Sv range, and 1 in excess of 8.0 Sv.

(10) Over the 82 days of continuous operation in Goiania, more than 130,000 man hours were expended in the monitoring and cleanup operations. This included the work of 244 CNEN staff members: 125 professionals from FURNAS, NUCLEBRAS, the Army School of Specialization, the Navy, and the Air Force; and 351 workers from private enterprises and the Goias state staff.

(11) The International Atomic Energy Agency provided 144 man-hours of assistance and the bilateral cooperation contributed another 656 man-hours of assistance. In addition, volunteer medical and technical experts provided another 616 man-hours of assistance.

(12) The final radiometric evaluation of all of the contaminated areas was completed in December 1987 and demonstrated that the equivalent doses should be less than 300 mrem/year for residents living within 50 meters of the original radiation sites. For individuals living beyond 100 meters from the principal sites, equivalent doses should be similar to that of the normal background.

In addition, considerable data regarding problems in conducting the autopsies, treatment of lesions (innovative grafting techniques), treatment of internal hemorrhaging (particularly in the use of Azul da Prussia), and so on were collected, but these very particularistic data simply serve only to amplify on case-specific information already collected. Thus, these data will not be discussed here.

Even with the small magnitude of the Goiania accident, when the absolute number of individuals involved is considered, the event has been characterized by many as one of the most serious nuclear-related accidents in history, second only to Chernobyl. In terms of the number of fatalities, it is the worst nuclear accident documented to have occurred in the western hemisphere. However, when measured in terms of fatalities and injuries alone, the event itself hardly seems to be of international significance -- certainly no more so than any other serious industrial accident. On the other hand, the secondary consequences have been considerable! The course of these events, the channels through which the impacts have occurred, and the aggregate socioeconomic impacts have indeed been remarkable. These may be usefully categorized into economic, political, and social consequences, and are individually addressed in the succeeding sections of this report.

3. Medium-Term Economic Consequences

A third objective was to assess the medium-term *economic* consequences. What have been the enduring economic impacts of the event? For those that have continued, how and why have they persisted? For those economic impacts that have not persisted, what forces brought them to a close?

The objective of this second visit dealing with economic impacts was focussed on updating, quantifying, and documenting economic impacts in the following categories: federal and state expenditures; agricultural and textile product costs; property (land and housing) costs; cleanup (materials, labor, site) costs; and service (hotels, transportation, tourism) costs.

Federal and State Expenditures. Total expenditures for monitoring, cleanup and treatment of the victims by the federal government, through April 29, 1988 (excluding all state, city, and volunteer assistance costs), are estimated (by the Director of CNEN) at Cz$ 400,000,000 (or about US$ 2,850,000). Representatives of the State of Goias "are still adding up the costs" but published estimates range to over Cz$ 2,000,000,000 (US$ 14,250,000) (*Ciencia Hoje*, "Autos de Goiania", March 1988).

Agricultural and Textile Product Costs. The impact on agricultural products was dramatic. Within two weeks of the event (i.e., the October 1, 1987 television dealing with the contamination), the wholesale value of components of the state's agricultural production fell by as much as 50%. It is useful to note that all of the major beef and agricultural products of the region and state (including cattle, rice, and other grains) are produced outside of the community of Goiania and none have been shown to be contaminated in any way. Manufactured goods, including textiles, clothing, and other finished products were also affected. The sale prices for such items produced in and around Goiania (and to some extent throughout Goias) dropped by approximately 40% immediately following the announcement. None of these items were ever shown to have been contaminated. In fact, as far as we were able to determine, there was never even a published suggestion that they could have been contaminated. A solution for some of these problems, however, was identified within three weeks--simply remove identifying

labels and replace with new names (i.e., phony labels). This solution worked very well and retail sales of manufactured goods recovered quickly.

The average loss of 30% of official sales (i.e., on which taxes are paid) for October and November amounted to perhaps Cz$ 1 billion (US$ 7 million), while the aggregate losses to local farmers has been put at closer to US$ 12 million. It is important to note that the impact on the sub-rosa (i.e., those products which pass through the economy without official taxes -- the vast majority of goods) would be several times greater. The aggregate losses for the period, compared with same period in 1986, have been estimated at 23% of total export value (*Ciencia Hoje*, "Autos de Goiania", March 1988).

All agricultural products are produced outside of the community of Goiania. The major products include beef, rice, and other grains. None of these products were ever shown to be contaminated in any way. However, wholesale value of the state's agricultural products fell by 50% beginning almost immediately following the television broadcast describing the accident. How did this come about?

As we begin to look at the process "on the ground", a pattern of impact begins to appear--a very widespread and consistent pattern. This pattern occurs at the point of contact between the producer and the market--i.e., between the producer and the middleman (or wholesaler). Without going into fine detail about how sales information was transmitted among middlemen (and among producers), about the various strategies employed by the middlemen, and so on, the unifying operative principal was that a "window of opportunity" had been identified by the wholesalers. Producers were immediately concerned about the potential impact of the accident on the value of their products. Wholesalers simply took advantage of the fears and concerns of the producers. They saw an opportunity to play on the producer's fears and worked to exaggerate these fears--to the point where individual producers were willing to absorb a 50% loss in order to "dump" their perceptually "tainted" goods. They were, in a real sense, predisposed to the arguments of the wholesaler that Goias products would be much more difficult to sell and therefore could only be purchased at a discounted price. With the discovery (near the end of the first month) that wholesalers were selling these same products in the national markets at nearly normal levels, the farmers responded. Producers, under the auspices of the "Commercial and Industrial Council" formed a united front and refused to

sell their products for less than an agreed amount (i.e., the "normal" selling price). This effort was largely successful and normal sales prices were reinstated.

The period between November 1987 to January 1988 saw a fairly rapid recovery of wholesale prices, to approximately 90% of original prices, with the recognition and acceptance of the fact that none of the products exported from Goiania (except for several loads of paper for recycling) were ever found to be contaminated. Between January and April, 1988, however, there has been little improvement in prices. As a result, the Goiania business association (Commerce and Industry Association), has grown increasingly concerned about their inability to reestablish earlier prices.[4] The Association attributes this inability to the concerted effort of other states to magnify the Goiania accident and to use this misfortune to better their own competitive position. While we were initially inclined to interpret these changes simply as a result of individuals working to maximize their own competitive advantage, we now recognize both the potential power of organized market manipulations and the profound incentive. Essentially, the event provided a focus for efforts of business organizations in other cities and states to unite in opposition against the city of Goiania and State of Goias. This strategy continues in many subtle and insidious ways. Unfortunately, the informants were unable to provide documentary evidence and it is unlikely such information will ever been available. A visit with business associations in Matto Grosso or Belo Horizonte might, however, provide additional insight into motivations and strategies. It should be added that there was a very strong feeling among those interviewed that a loss of 10% was a very significant impact and that a difference of even 5% would be considered a serious overall impact, since the "margin of profit" on many of the products produced in Goias were right in this range. It was very clear that this was a continuing issue and would remain the subject of much planning among the members of this group.

Thus, it can be concluded that Dr. Petterson's original belief that the system would essentially fully recover after the first few months was inaccurate. While, from one perspective, there has been a rather remarkable rebound in the economic system, from another perspective, the inability of the system to recover to acceptable (i.e., pre-

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[4] Follow-up meetings were conducted with the economic agencies, tourist offices, and additional interviews were conducted with several key local and state officials in Goiania.

accident) profit levels, even 8 months after the event, has important implications for accident scenarios in the United States.

Another significant implication of the economic consequences of the Goiania event was the differential impacts that occurred on the various economic components of the system. Some products were unaffected by the accident, while others suffered losses in excess of 50% for several weeks or more. Basically, these differences resulted from: (1) the character of the association between the product and the state of Goias or city of Goiania (i.e., name association, product association, geographic association); (2) the media identification of particular products; and (3) the labeling characteristics of the item (i.e., whether or not the name "Goiania" or "Goias" appeared on the label of the food product or manufactured item). It should also be obvious that some items (especially perishable food products) are inherently more susceptible to the effects of very small changes in demand resulting from an accident, some (such as livestock) are subject to abrupt major impacts with very rapid and relatively complete recovery, while others (such as grains and manufactured goods) are relatively insensitive to major change but susceptible to small but enduring changes.

Property Costs. During the first three months following the accident, there was a very definite impact on the number of homes sold, home sale prices, rental prices, and land prices. These impacts tended to increase with the geographic proximity to the contaminated areas. In the immediate vicinity of the accident itself, prices plummeted. While very few homes are being advertized in the immediate areas, there is a belief (vocalized by local residents) that home sale prices have remained below the pre-accident levels, though they have clearly recovered considerably from previous months. Substantive data remains to be analyzed to quantitatively support this belief. A newspaper content analysis and data from real estate organizations will be used for this purpose.

Cleanup Costs. The clean up activities were basically concluded on December 21, 1987 and are also addressed in the earlier discussion of physical impacts. The termination of cleanup activities, in addition, initiated a major internal technical controversy over what constitutes "an acceptable level of safety". The debate centered on what standards should be employed to determine acceptable levels of residual contamination. While there remain several sites in the city which register radiation levels above the national

workplace standards, there is considerable debate about whether these should be the standards employed. In any case, it was finally determined that the social and economic costs of achieving smaller and smaller improvements in radiation levels exceeded the benefit of the added protection and a final termination date was established. It was not until after it was announced that cleanup activity had been completed (and that the CNEN crew would be withdrawn) that the controversy over what constitutes an adequate level of safety entered the public domain. The CNEN held to its schedule and has consistently maintained that all of the sites met adequate safety margins and pose no risk to residents.

Service Industry Costs. Hotel occupancy, normally near capacity during this season of the year, had vacancy levels averaging about 40% for the six weeks following the television broadcast (i.e., through November 16, 1987). The Hotel Castros (one of biggest in Goiania) lost an estimated 1000 reservations as a direct consequence of perceived risk and stigma (a drop of nearly 60% in reservations for October). Conventions for General Motors, the Corrides Stock Car Association, Comansu Tractors, and the Regional Medical Association were all canceled in response to the perceived risk and stigma associated with the accident. Representatives of the National Industrial Exposition (Feira do Provencia) officially "uninvited" the State of Goias' exposition. Only after forceful intervention by leading religious leaders (and considerable consultation with technical authorities) was this decision rescinded.

An exception to the short-term negative impact on hotel occupancy was the Umuarama Hotel, in Goiania, which was filled with more than 100 technicians from CNEN, out-of-town newspeople, political visitors with their entourages, and other visitors concerned with the accident. By the time of the second visit, hotel occupancy and convention attendance had returned to "near normal" levels. Hotel managers claimed that there had been virtually no enduring impact on occupancy levels nor did there appear to be any lingering concern about possible contamination.

The leading tourist attraction in the vicinity of Goiania is the small community of Caldas Novas, approximately 1-hour drive from the city. Caldas Novas is a community that owes its existence to the presence of what is perhaps the largest concentration of hot springs in the world. Numerous hotels have been constructed to take advantage of these natural springs. Gigantic swimming pools, water falls, and streams are present throughout the

area. Even though reservations and advanced payments are normally required, the occupancy rate dropped between 30 and 40% immediately following the television broadcast. Data obtained in the second visit showed, however, how rapidly the public can re-establish its patterns, particularly its recreation patterns. Admittedly, this case was unusual on two important grounds: first, it was some distance from Goiania (and was therefore only distantly associated with the accident in the first place); and, second, many Caldas Novas hotels required prior payment (thus forcing reservation holders to make a very hard choice between losing a great deal of money and assuming the potential risks of going to the hot springs). In any case, by the end of the second month following the accident, attendance levels had resumed their prior occupancy levels.

4. Medium-Term Social Impacts

A fourth objective was to assess the medium-term *social* impacts. As related in the synopsis of the first visit, the sources and range of potential social stigma (or "discrimination", as the Brazilians call it) are extensive. The number of social impacts is unusually robust. Social consequences of the incident are among the most interesting, most extensive, and perhaps most enduring.[5]

Many of these social consequences are still evolving, but among the most noteworthy of the social issues witnessed to date, are: (1) the effects of the media; (2) the effects of the radiation monitoring program; and (3) a number of miscellaneous specific social interactions that have occurred.

The Effects of the Media. To begin with, there are two salient points to be stressed -- points that were key in understanding the role of the media in the Goiania radiation event. The *first point*, and one that is really directed to those charged with the management of a similar crisis, is that a healthy respect for the power of the media is

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[5] Among Goiania residents, the Vox Populi survey showed that 72.4% believe that the residents of Goiania have suffered discrimination (i.e., stigma effects), while 59% claim to have actually experienced such discrimination outside of the community. Of those surveyed, 35.6% claim that the accident, in one form or another, had negatively affected their lives. Assuming that this is a statistically valid sample, the implications of these findings are indeed significant and bear an important relation to the Nevada accident scenarios.

required, as well as an understanding of the business of reporting the news. The media is not a single entity -- it is a field composed of an array of businesses in competition with each other. Their stock in trade, in times of crisis, is the sensational nature of that crisis. The business of the newspapers is the sales of newspapers; the business of television or radio news is increasing their audience at the expense of other news entities (increase in market share). In the atmosphere of trying to "scoop" other news entities, subtleties of the event may be enhanced or the public's fears may be heightened out of proportion of the nature of the event itself. Scientists and bureaucrats not used to dealing with the media who end up as spokespersons for institutions or government agencies often make matters worse, which brings up the *second point* learned from the Goiania incident: the governmental institutions responsible for the management of a nuclear crisis must be cognizant of the needs of the news media in times of crisis and they must be organizationally prepared to meet those needs.

It is often said that it is a whole lot easier to "scare" someone than to "un-scare" them.[6] This should not be seen as a simple cliche. It is an important issue, particularly in the area of communication. How, when, and by whom information is transferred are all of critical importance in determining what is communicated. What is communicated, in turn, determines in great part the social, economic, and political consequences of the message.[7]

There are a great many aspects to each of these issues. How the information is transmitted, whether by television, radio, newspaper, word of mouth, etc., is a major determinant affecting both the number of people who will be receiving the message and what message they receive. Some news sources have a great deal more credibility than

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[6] It is interesting, though perhaps counterintuitive, that a recent survey conducted by the Instituto Vox Populi (completed in May, 1988), of 1,457 residents of Goiania and neighboring communities, showed that only 13.7% of the Goiania respondents feared the occurrence of another nuclear-related accident while 81.6% of the residents in surrounding communities had such fears.

[7] The Instituto Vox Populi study cited above also revealed a number of interesting beliefs about the media. For example, of those interviewed, 61.3% disapproved of the media coverage of the accident, while 33.2% approved of the coverage. According to the survey, 34.1% of the respondents felt the media understated the facts of the accident while 27.2% felt the media had exaggerated them.

others. When the information is transmitted will also profoundly influence potential consequences. Early messages, all things being equal, will have a far greater impact on beliefs and behavior than later messages. Thus, it is of critical importance that the very first announcements be carefully worded, clear, and concise and written at a level that will permit a minimum of misinterpretation.

While we have only just begun to analyze all the media reports that have been generated over the last seven months,[8] it is already evident that the role of the media in propagating and perpetuating the socioeconomic impacts of the event have been dramatic. Having concentrated thus far primarily on collecting the behavioral side of the equation, it should prove quite interesting to analyze the relationship between these human reactions and their possible origins in news accounts. Unfortunately, from an analytical standpoint, we firmly believe that the role of television has been even more profound than either newspapers or the radio and while we have gained access to a source of nearly 2,000 hours of documentary and broadcast news film, the cost of a detailed analysis of this material is considerable.

At issue is the way the event was handled by the media. To a large extent, the media's reaction virtually assured that a panic would ensue. Public perception of the accident shifted from a casual newspaper report, that several individuals had been irradiated from a "stolen" radiation device, to a full-scale sensationalistic television broadcast on the nuclear accident and widespread radiological contamination in the city of Goiania. This broadcast was based upon scant information, was rushed to beat the competition, was presented by a well-respected journalist, and originated from a large city (Sao Paulo) television station; it made little or no attempt to calm the population of Goiania.

This particular broadcast marked, in our estimation, the beginning of the broader social impacts of the event. Once initiated, there would be no turning back. Literally overnight, an army of newspaper reporters, radio and television reporters and crews, and

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[8] We have collected virtually every relevant article from the major newspapers published in Brazil since the accident (perhaps five hundred articles in all) These articles are currently being translated and entered on a computer database for indexing and key-issue sorting.

international media representatives and crews, etc., descended on the community to cover the crisis, with the express intent of competing with the other media representatives.

What is clear from both the subjects, the newspaper reports, and discussions with reputable reporters, is that several dozen journalists competing for a "scoop" can generate an awesome array of both individual and collective perspectives on an issue and that the combination of these perspectives can lead to considerable exaggeration, serious errors of fact, and outright fabrication. One of the more useful outcomes of this work in Goiania might be to organize a set of concrete recommendations on how to handle the communication process since many of the informants volunteered very pointed "lessons learned" with respect to the media, for example, with respect to the use of such words as "contamination" and "radiation", with regard to authority, responsibility, and chain of command, and with regard to minimizing public distress. There were many, many mistakes and lessons learned.

To further illustrate the impact of the media, there are two examples which should prove informative. In the first case, a Goiania newspaper carried the quote of a local health official who, when asked who was at most risk of exposure and what could be done to minimize personal exposure, advised that "pregnant women and small children should remain at home and that domestic animals should be kept inside." While this would, under normal conditions, be a relatively innocuous suggestion, under prevailing conditions, the population of Goiania was predisposed interpret this information as a threat -- with the result that anxious pregnant women surged to the monitoring station, school absences skyrocketed, and stray animals were routinely and systematically shot.

The second example is given by the events that surrounded the effort to bury the first victims of radiation exposure in the local cemetery. The construction of the massive lead-lined casket itself was followed very closely by the media for several days, as was the growing concern among residents that the entire cemetery would be contaminated. The hearse carrying the first fatality, a six-year-old girl (who was to be ". . . buried along with her radioactive dolls"), to the Goiania cemetery was blockaded and then stoned, forcing the driver to flee. The police were able to scatter the protesters and the burial was completed. However, the presence of this casket in the cemetery remains an enduring source of concern to many.

Public response to the reporting of the Goiania incident suggested that written statements prepared by the cognizant agency distributed before or after public discussion, could go a long way toward contributing to media accuracy and balance. It must be made clear to all those in institutions that have responsibility for dealing with a crisis that there are serious potential consequences of dealing directly with the press, that their personal comments will be included as "one informed source" or from a "source in the command post," etc., which tends to enhance the status of the source. It is important to officially notify media representatives, in public and openly, that only certain individuals are considered authoritative and that efforts to "build" stories would have serious negative impacts on community, and result in a serious breach of understanding with responsible authority. A clear line of communication with the authorities dealing with the case is deemed essential, and the authorities need to be seen as responsive to the legitimate questions of the press and public. Thus, responsible authority must make these connections almost immediately, have a formal agenda and calling sequence which will assure that all (or most) of such authorities are aware of the situation directly through the central authority, are briefed about the possible unintended consequences of their remarks, and specifically what the agenda of the media personnel are likely to be, and how this might itself create detrimental consequences above and beyond those of the real risks.

There must be a "point of contact" through which to channel the flow of information efficiently, and this should be as close as possible to initial incident site. To minimize the effects of perceived risk, individuals responsible for informing the public must have personal credibility and a reputation for integrity (i.e., something to personally lose if deceitful), and high official status (i.e., a major job to be lost if the individual is less than truthful).

If one wishes to conduct an analysis of the effects of the media on public perception, it is important to realize that each media entity ("information filter") is configured to address a distinct component of community and must be examined independently and diachronically as "pockets" (e.g., radio has its own set of constraints and methods of operation; television has a different agenda and set of constraints). They also operate at different levels (local, city, region, state, national), and on different populations (radio affects population in different ways from TV, newspapers, etc.). In effect, each operates as a independent magnifying glass on the event, looking for the most "newsworthy"

aspects (as defined above) of the event, and competing for space or time with other events, but the public receives a composite picture from a plurality of sources.

Effects of the Radiation Monitoring Program. Once the source of the problem had been identified in the media, a virtual panic ensued. Concern very quickly reached the point where the CNEN had to establish monitoring stations to check people for contamination. By the time of the first visit to the community of Goiania, i.e., in mid-November 1987,10% of the city's population (over 100,000 individuals) had, of their own volition, stood in lines to be monitored with Geiger counters for signs of external radiation. By the time of the second visit (in late April, 1988), over 125,800 persons had come to the monitoring station to be checked for contamination.

It is important to recognize that the entire "monitoring" effort (i.e., being checked from head to foot for contamination) was a response to perceived risk. The state and federal governments did nothing to encourage people to come in for monitoring. They worked hard, in fact, to calm fears and to discourage people from coming in to be monitored. The fact that 125,800 people were afraid that they might inadvertently have been contaminated is a significant statistic. Approximately one of every ten residents of a city of over 1,000,000 felt sufficiently at risk to take time off work, to use weekend or after work hours, to travel across town and wait in line to have someone scan his or her body with a Geiger counter for potential contamination. This is a profound behavioral response to a perceived risk! We may wish, however, to consider the monitoring effort from another perspective. Given that 1 out of every 10 residents decided to go to the effort, and assume the risks of being monitored (a process, remember, to which a certain level of stigma and active discrimination was automatically attached), how many people might we assume *almost* came in to be monitored? How many more, in turn, were sufficiently concerned to have *seriously considered* the idea? From this perspective it should be evident that nearly the entire population was, to one degree or another, drawn into a terror of radiological contamination founded primarily on the social perception of risk.

We must remember that virtually every individual who was found to be contaminated and was then successfully decontaminated, would then be subject to various forms of discrimination. The fact that they had been contaminated at one time was sufficient cause for social discrimination and prejudice. This also applied to individuals residing on

57th Avenue, which was one of the nine principal "distribution" points for pieces of the cesium material, as a result of the fact that they lived on a street known to have been such a focal point. Schools would not let children of exposed parents return, a situation which required direct intervention by state medical personnel in order to get these children to return to school. There are instances of schools requesting that monitoring personnel inspect all public areas, but even after it was demonstrated that the area was "safe" school officials would still reject the interpretation of the inspectors.

It should be made clear, however, that unlike the Orson Welles "invasion" example discussed earlier, there was a very small, but real, risk that an individual had been contaminated. Of the 125,800 individuals monitored, 249 (approximately 1 out of every 500) were found to have been contaminated. Of these 249 cases, 120 involved contaminated clothing (requiring the destruction of clothing and cursory decontamination bathing) and 129 involved some form of internal or external contamination. Of these 129 cases, only 20 were sufficiently contaminated to require hospitalization. Of these, four individuals would eventually die and one individual would have an arm amputated. However, these statistics tend to significantly exaggerate the "actual" risk of contamination since, with very few exceptions, significant cases of contamination were limited to: (1) those known to have been in contact with the primary victims (immediate families, relatives, friends); or (2) those who worked in the same "occupation" (i.e., paper and metal scavenging).[9] If those individuals with "good reason" to be concerned could

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[9] An entire book could easily be written about the scavenging "business," which would include a description of: (1) the mafia-like organization of this "industry"; (2) the fears of these people that they might be recognized as the primary public "carriers" of the contamination (which indeed they were), and be killed "just like a stray dog or cat"; (3) their efforts to conceal their role in spreading the contamination around the community; and (4) the personal conflicts they had to deal with in deciding whether or not to come in for monitoring and reveal their presence. Many of them, of course, elected not to present themselves for monitoring and therefore continue to pose a public risk. Even if they ultimately die from their contamination, it is unlikely that the cause will ever be known, as autopsies are rarely performed on members of this sector of the population. This is of more than anecdotal interest, however, since the same or similar fears and psychological processes could be expected in the event of a similar accident in the United States. Such an accident could be expected to give rise to very similar reactions to the monitoring effort (i.e., a personal fear of the monitoring process, fear of the possible stigma attached to simply being monitored, fear of actually being identified as a "carrier," fear of being discriminated against, and fear of being ejected from one's own family, etc.) and similar consequences (continued spreading of contamination, prolonged social and economic effects of the event, higher death and injury toll, etc.). In addition, it should also be clear that certain groups or social classes are very likely

have been separated from those whose fears were founded only on perceived risks, the number of "discoveries" accounted for by the monitoring program would have been much smaller. In fact, one of the technicians interviewed noted that coming in to be monitored was perhaps the riskiest thing an individual could have done in the aftermath of the accident because of the increased likelihood that he would come into contact with someone who actually was contaminated, which is an interesting notion.

Perhaps the most important finding of our examination of the impacts to individuals as a result of the Goiania event was the fact that of the first 60,000 individuals to be monitored, approximately 5,000 individuals (8.3%) presented acute stress or allergic symptoms (i.e., rash around neck and upper body, vomiting, diarrhea, etc.) (pers. comm. Donald Binns).[10] Curiously, the majority of these individuals claimed that these symptoms had begun after the capsule was broken but before the announcement in the news media. Not a single one of these individuals was contaminated! This has profound implications for the study of perceived risk in general and "special" nuclear-related impacts in particular. Unfortunately, we were unable to conduct interviews with any of these individuals in either the first or second field visits, but it is believed that a careful examination of this phenomena will reveal some very profound and universal characteristics of human response to perceived risks. This will be a high priority objective in subsequent visits to Goiania.

Another interesting observation was the fact that the majority of these victims claimed that the symptoms began before the announcement of the accident (but, of course, after the accident itself). The obvious interpretation is that they were simply attempting to establish the credibility of their exposure. But many of these individuals were adamant that their symptoms began before the press began its onslaught -- even after it was

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to be differentially affected by any particular accident scenario. In all likelihood, those in the lowest socioeconomic levels are also the least insulated against negative social or economic impacts, while those in the higher economic groups are the least likely to be seriously affected.

[10] Each such "victim" was treated in the following way: (1) they were informed that their symptoms were in no way related to exposure to cesium; (2) they were referred to a pharmacy or dermatologist for treatment of their rashes or diarrhea; and (3) they were told that their symptoms were caused by stress. None of these individuals returned for a subsequent monitoring and it is assumed that their symptoms disappeared.

made clear that they had not been contaminated. The simple interpretation, that they may have been lying to support their claims of exposure, may not be adequate. There is something else going on here. As an alternative interpretation, it is theorized that many of these "victims" were indeed experiencing one or another minor (or major for that matter) allergic reaction during the period immediately preceding the announcement of the accident and "locked on to" or shifted their perception of the source of their symptoms to the new concern-- cesium contamination. Once established, this interpretation would become a sort of self fulfilling prophecy, maintaining and even magnifying the acute stress reactions and symptoms. Because a certain percentage of the population of a city of 1,000,000 residents could "normally" be expected to be predisposed to adverse stress reactions (discussed again below), it is not difficult to see these same individuals coming to believe their symptoms are related to the profound source of new stress in the environment.

It should be pointed out, however, that the technicians have made little effort to monitor such conditions for the last 40,000 or so individuals coming in to be monitored. This is because the symptoms seem to have ended entirely. This is yet another interesting observation. One wonders why the number of stress cases would fall off precipitously after about the first month of monitoring.

Several reasons can be posited for this rapid rise and decline in psychophysiological stress cases. First, there is probably a differential susceptibility to stress reactions. Since only 8.3% of those who were sufficiently concerned about exposure to come in for monitoring showed such symptoms, we can probably conclude that within any particular population there will be some standard distribution of those who are predisposed toward stress reactions. On one end of the continuum, individuals will suffer severe reactions to rather modest stressors while on the other end of the continuum individuals will appear unaffected by even the most severe stressor. From this example, we can predict that any major perceived risk, particularly one that affects people across distances, penetrates clothing or other material, cannot be seen, touched, or in any way perceived through the senses (i.e., involves mysterious, magical processes), with unpredictable physical consequences, will provide this latent population with a focus of attention and will result in their participation in any monitoring program. Their reactions, in turn, could affect public perception of the risks involved. This observation has important implications for the design of emergency response plans.

While the implications are unclear, it is also certain that the rapid fire sequence of new stresses characteristic of this kind of evolving emergency will result in some residual effect. On the other hand, there must also be some natural period during which humans acclimate to stress conditions -- at least during which time the acute indices of stress might begin to taper off. In the above case, the number of individuals already suffering aliments with unknown or mysterious etiology, i.e., those predisposed to interpret their symptoms as related to the nuclear accident, must be relatively fixed and therefore, in a sense, self-limiting. It should be mentioned that there were also individuals who returned to be monitored every day. Clearly, these individuals fall on the extreme or hypochondriac end of the continuum of predispositions, and perhaps no amount of information could convince them that they were not contaminated or that they would not, in the next few hours, become contaminated.

There was another, very distinct, group of individuals who came in to be monitored. For many of these individuals the intent was not so much to satisfy themselves that they were not contaminated as to secure an official document, issued by the CNEN, that certified that the individual's home, article of clothing, agricultural product, or manufactured item was not contaminated. More than 8,000 residents requested and received official certification that they were not contaminated. These certificates were requested in an effort to counter the stigma that come to be attached to residence in Goiania as evidenced by: (1) hotels in other parts of the country refusing to allow Goiania residents to register (e.g., in Sao Paulo, Cuiyaban, and Manaus); (2) airline pilots refusing to fly with Goiania residents on board; (3) bus drivers refusing to allow Goiania residents on their buses; (4) stoning of automobiles with Goiania license plates; and (5) virtually all conventions originally scheduled for hotels in Goiania during this period being canceled or rescheduled for other communities.

Unfortunately, this effort resulted in mixed reactions due to the fact that Brazilians, for the most part, didn't trust the certificates. They believed that were probably forged or meaningless. In some cases, in fact, they had the unintended effect of confirming that and individual might have been contaminated (was at least himself concerned that he might have been) and now was so worried that he obtained a phony certificate.

Inasmuch as the capsule containing the cesium-137 material was opened at a salvage yard in Goiania, there was also a major issue regarding the contamination of paper goods -- especially scrap paper. Although many tons of paper were contaminated, there was only one reported shipment of scrap paper to regions outside of Goiania -- a shipment to Sao Paulo. CNEN also monitored paper money passing through the principal banks. The results of this monitoring revealed that a total of 68 bills (out of a total of 10,500,000) were found to have been contaminated.

As a final point, and just for balance, the monitoring of sites (as opposed to walk- up requests) turned up a number of individuals who were significantly contaminated and even though they were aware that they were at relatively "high risk" of contamination, they nevertheless elected not to come in for monitoring. We believe a fair description of their attitude would be something akin to "I don't believe in radiation, so why should I bother". This attitude, in some cases, seemed to endure even after demonstrably high radiation readings. Obviously, some individuals will fall on the opposite extreme of the continuum and cannot or will not be convinced of the existence of a threat. These individuals, depending on their position in the overall scheme of things (i.e., as risk managers, decision makers, doctors, nurses, or as carriers of contamination) can pose their own sets of risks.

Miscellaneous Social Interactions. A number of miscellaneous social interactions were observed during the recent follow-up visit to Brazil and are worth of noting in this report. These interactions are generally characterized as government-citizen interactions, government-victim interactions, neighborhood discrimination, and guilt by association. Each is described below.

- Government-Citizen Interactions

  One of key factors affecting the general level of uncertainty regarding the Government's reports concerning the status of the Goiania situation was the firmly established disbelief in the "word" of the government. It is assumed by the Brazilian citizenry, for example, that the government will go to any lengths to cover-up an incident such as that occurring in Goiania. There is, in fact, a very

strong historical basis for this belief, but the historical record will not be discussed in this paper.

- Government-Victim Interaction

Very soon after the initial victims were diagnosed federal police came to the hospitals to "investigate" the cause of the accident. This investigation served to close off a source of information because of the accusations of responsibility and threats of prosecution that evolved during these hospital visits. Victims felt completely ostracized and isolated. This was a serious problem to the technicians attempting to identify and decontaminate sources of radiation because the victims would no longer tell them where they had gone during the prior two weeks, who else might have been contaminated, what they sold, if they had sold goods to other communities or shipped potentially contaminated items to other communities, and so on.

- Neighborhood Discrimination

Discrimination existed between individuals from 57th Street and 16A Street areas and all others at work, among closest friends, and even between parents, brothers and sisters. In the first weeks after the accident, individuals from outside these neighborhoods (and even within these neighborhoods) would avoid each other in an effort to insure against contamination or other social contacts that might implicate them in the discrimination. There were even instances whereby individuals exposed (but later decontaminated) were treated as pariahs. People who were at any time contaminated (and then decontaminated) were treated as if they were still "contagious." This social interaction continued strong for nearly two months after the incident.

- Guilt by Association

Brazilian cities, such as Goiania, are broken into Setors (Sectors) which are essentially large named neighborhoods--such as Central, South, and University

Sectors. The accident occurred in the Setor Aeropuerto (Airport Sector) which was named decades earlier when it was actually near a now non-existent airport. Early news accounts claimed the entire area surrounding the "airport" had been contaminated which had an enduring impact on travel to or through Goiania (perhaps even affecting travel between Rio de Janeiro and Brasilia since Goiania is a stopover between the two). Even within the community, however, the stigma attached to the area is strong. Requesting to go to Setor Areopuerto would often generate some quip regarding radiation, contamination, or "contagion" from taxi drivers. Each geographic distance carried a different level of stigma. The worse case, of course, applied to the residential street where the first victims lived, "Rua 57" (57th Street). One need only mention "Rua 57" to open a discussion of contamination, fear, economic impacts, etc. The number 57, in fact, was sometimes sufficient.

5. Medium-Term Political Consequences

The fifth objective of the follow-up study was to conduct an assessment of the medium-term *political* impacts of the accident. The specific objective was to further define and characterize the effects of the accident on local and state regulatory policy and regulatory implementation process, on the general political processes within Brazil, on the outcome of legal charges, and to characterize the issues of legal and economic liability.

One of the key issues examined was how the accident has affected institutions such as the Nuclear Energy Regulatory Commission (CNEN). Beyond the existing institutions, this accident may have far-reaching programmatic implications -- the issue of concern is how the accident has affected national "nuclear" policy (with respect to nuclear power reactors and nuclear weapons development).

Also of interest was an assessment of the longer-term ramifications of the event on political processes, such as the political relations between the city of Goiania and other cities, between Goiania and the state of Goias, between Goias and other states, between Goias and the federal government, and between other states and the federal government. The event did not occur in a vacuum; rather, it was set within an the context of active

and complex domestic political environment. It has also become clear that international political consequences were generated by this radiological materials accident. So, what on the surface would appear to have been a localized event, has had far-reaching consequences on each of several political levels, including organizational and programmatic effects on *institutions*, consequences for *political relations*, and also certain *legal* consequences.

Consequences for Institutions. The incident has had a profound effect on Brazil's institutional organizations dealing with nuclear matters and has also had some serious effects on the public's attitude toward the nuclear program in this Third World country. The political consequences of these issues are discussed in the following subsections.

- Political Consequences and Institutional Organization

  Above and beyond the technical aspects of the problem or emergency, the incident had a significant effect on the organization of the cognizant regulatory agency, the CNEN. As a product of the blame levelled at the CNEN efforts were made to reassign their responsibility for a variety of activities (because they were "overworked" in government parlance), and legislation has been submitted to congress to split the agency into several distinct divisions (licensing, monitoring, enforcement, and research).

  Internal operations of the agencies involved have been seriously affected. The accident has focussed attention primarily on this single issue and diminished every other legitimate mission, some of them critically important. Agency directors have been totally dominated by the issue; some worry that they too may be subject to criminal charges, and concentrate their time on defending their agencies or themselves. In any case, their attention is focussed on this particular issue to the detriment of the agency's overall mission.

  There are at least two major structural problems with preparing a regulatory agency such as CNEN to deal with a problem such as the Goiania accident. The first is that low-probability events are difficult to remain prepared for, given limited budgetary resources. In order to deal efficiently with such accidents,

there must be a number of resources in place that can be quickly and efficiently mobilized. If these resources are not utilized for many years, it is difficult, bureaucratically, to maintain resources in a state of readiness without the funds being used for other purposes. Second, there is the problem of training the staff to adequately handle a set of circumstances in a crisis situation that they have never had to deal with before. It is not difficult to imagine that such crises would be the first time the bureaucrats would have to deal with this sort of event, that is to say, they are likely to occur, on the average, more than one "bureaucratic lifetime" apart. It is difficult to adequately practice for what are, from the individual perspective, entirely unique events.

In addition to the flaws of regulatory policy and the regulatory implementation process that became obvious after the fact, a number of other fundamental questions have remained unanswered. Who is responsible for reimbursement, mitigation, and compensation?[11] What about accountability? There appeared to be none. The state agencies placed responsibility on the CNEN; however, CNEN identified the State Department of Health as the responsible agency. The State Department of Health asserted that it could not be held responsible, as it has no specialists trained to inspect radioactive isotopes, and asserted that nuclear waste is the exclusive province of CNEN.[12] The Federal Health Ministry, for its part, claimed that its unit for inspecting radiotherapy facilities had been disbanded and that a new unit had not been set up for that kind of work; thus, the Ministry claimed that CNEN was responsible.

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[11] In the Instituto Vox Populi survey identified earlier, the actions of the federal and state governments were praised by 68.8% of the respondents, while 33.8% held the government responsible and 26.9% considered the clinic owners who abandoned the device to be guilty of a crime. A total of 95.6% of the respondents felt that the government had not done enough to inform the public and should therefore initiate a public information campaign to remedy the situation.

[12] Regarding the question of radioactive waste, the Vox Populi survey showed that 77.6% of the residents of Goiania and neighboring communities felt that each state should be responsible for the disposal of its own waste within its own boundaries.

o Political Consequences and Programmatic Effects

One of the consequences that may come out of the Goiania incident is a long-term influence on the direction of nuclear programs. It appears that there is a good deal of cognitive lumping on the part of the public, and this may have serious programmatic implications. The term "cognitive lumping" refers to a situation where a set of phenomena are grouped together in the mind of the public, without an appreciation for the significant distinctions between the individual phenomena. In this case, public demonstrations against nuclear power, nuclear bombs, nuclear waste, and so on, tend to meld in the public's mind to the effect that articles dealing with cesium accident frequently draw in information on the issue of disposal of tons of contaminated waste, the issue of nuclear waste disposal in the larger sense, the issues surrounding nuclear energy facilities and their problems, and event the problems of siting high-level nuclear waste repositories in Brazil. Each of these issues, of course, have been addressed continually and in great detail over the last few years, and their interrelationships and constant presence in the press, and the impact of this presence, is instructive. All of these programs and issues have been the subject of intense scrutiny as a direct result of the cesium accident. There appears to be a "reservoir of fear" associated with what are little understood, but perceived to be highly dangerous, radioactive substances, and this reservoir may be tapped by any accident related to the set of phenomena. In this way, the public reaction, which may appear to be far out of proportion to the extent of the particular accident, may be understood in part.

Consequences for Political Relations. Political hostilities between geopolitical entities within Brazil were fomented as a direct result of the accident. The efforts of cities surrounding Goiania to prevent the accident from affecting their economies had serious impacts on Goianian exports and intercommunity travel and social relations. Similar efforts by state authorities to isolate the economic impacts in Goiania had an even more detrimental consequence. In the following analysis, four key political issues are discussed in greater detail: (1) the levels of jurisdictional conflict; (2) the fact that the accident served as a catalyst which fomented domestic political opposition; (3) the involvement of

international political interests in the incident; and (4) the roles of politics and crisis resolution during the decontamination process.

- Levels of Conflict

  Several levels of conflict were identified, in terms of the points of friction, contention, or dispute over administrative, legal, or financial responsibility that evolved as a result of the incident. A description of these various levels of conflict is summarized in Table 1.

- Accident as a Catalyst for Domestic Political Opposition

  The event has also provided an arena for political dissent, in effect giving a public forum to more or less distantly related opponents. A member of a minority party, as mentioned below, attempted to gain political leverage for his own efforts at election by bringing in an outside expert to counteract the official version of the event. This caused untold damage when the so-called "scientific" findings of this "expert" (which included grossly exaggerated radiation readings) were reported in the press. It seems that the accident provided an excellent issue upon which competing political factions were able to take a stand against all incumbents. Those opposed to "nuclear weapons, power, or waste" were able to muster considerable support for these initiatives.

- International Political Interactions

  On the international level, there are globally active environmental groups that have their own agendas that lead to their involvement in incidents such as the one in Goiania. In one instance, a member of the Brazilian "Green" party arranged to have a nuclear physicist from the German Green Party come to Goiania to investigate the incident , with the idea of providing an independent perspective. As part of this individual's efforts, he arranged to take radiation level readings at various locations throughout Goiania (mostly in and around known sites). The physicist was credited by the Brazilian press as being an

TABLE 1
LEVELS OF CONFLICT

Level	Conflict
Local/Local	There were conflicts generated between Goiania and neighboring communities centering on issues of travel and economic relations.
Local/Regional	There were conflicts generated between Goiania and neighboring regions, which again centered on issues of travel and economic relations.
Local/State (Goiania/Goias)	There were conflicts generated regarding who was to assume the administrative, legal, and financial responsibilities for the accident, and who was to be responsible for the waste disposal problem.
Local/Federal (Goiania/Brazil)	There were conflicts generated (similar to the Local/State conflicts) regarding who was to assume the administrative, legal, and financial responsibilities for the accident, and who was to be responsible for the waste disposal problem.
State/State (Goias/Minas, etc.)	Other states intentionally or inadvertently (depending on one's perspective) were able to take economic advantage of Goias' predicament. For example, according to the members of the Goiania Chamber of Commerce, concerted actions by other states to take advantage of Goias' predicament have exacerbated existing rifts between Goias and neighboring states, and have tended overall to significantly weaken Goias' relative political and economic position. The incident also initiated a rash of political actions by other states to prevent nuclear waste from being buried within their borders -- creating a major problem for the national government's efforts to locate and construct a high-level nuclear waste repository for anticipated commercial and military wastes. The State of Rio de Janeiro, for example, quickly passed a law prohibiting burial of nuclear waste within its boundaries. Other states have begun similar movements and tribal groups in areas slated for future national burial sites held protests in the capital.

TABLE 1 (cont.)
LEVELS OF CONFLICT

Level	Conflict
State/Federal (Goias/Brazil)	There were conflicts generated similar to the Local/Federal conflicts regarding who was to assume the administrative, legal, and financial responsibilities for the accident, who was responsible for the provision of services to victims of the accident, and who was to be responsible for the waste disposal problem.

international "expert"; this "outside" expert made a number of erroneously high readings (using a surface detector unknowingly selected to the wrong scale) which were quickly reported by the local press. As a result of these erroneous data points, a new level of concern was produced (i.e., the concern that everyone was being lied to by the CNEN, that the dangers were far higher than they had been told, etc.) and a whole new cycle of fears and reactions evolved. It later turned out that the physicist in question was a solid- state physicist with little experience with radiation readings; however, the political damage was done. He was working, in part, on an agenda that was principally focussed on issues relevant to his own country, not to Brazil.

- Politics and Crisis Management: The Decontamination Process

One of the major lessons learned in the Goiania incident is that mechanisms for crisis management must be in place before the crisis occurs. In the Brazilian event, an accident such as this was not anticipated. There were no contingency plans for the disposal of the contaminated materials that resulted from this accident, and there was not a public consensus on what should be done.

In fact, subsequent political decisions crippled decontamination process. Since there was no politically acceptable nuclear waste disposal site in the country (much less in Goias), cleanup activity was halted while an arrangement for temporary storage could be made. Political conflicts and debates over this issue were harsh, to say the least.

A site for radioactive waste disposal must be selected as part of any nuclear related work, and this site must be approved by the public -- it must be assumed that an accident will occur, and resources committed to based upon that assumption. (One recommendation could be that a site be selected and approved by the public, with a built-in compensation mechanism to the local population were it to become necessary that the site ever be used in a crisis.)

Legal Consequences. The first legal inquiry into the accident is due to be completed by mid-June, 1988, and in all likelihood the doctor and his associates who owned and

abandoned the clinic and the cancer therapy device will be indicted. The actions of the director of CNEN are also being investigated at this time. The issues of legal liability, criminal culpability, and regulatory responsibility are complex, and will take a significant length of time to sort themselves out.

6. Mitigation Measures

The sixth, and final, objective was to characterize local, state, and national measures that have been instituted to *mitigate* impacts from the incident. What new economic, social, or political groups have been formed or actions taken to maintain, quell, or magnify existing fears or perceptions? In essence, what lessons have been learned and applied over this period by individuals, social and economic organizations, and by the political leadership to protect the population from the effects of the Goiania accident or other nuclear-related accidents? The following is a discussion the economic, social, and political measures that have been employed by Brazil in coping with the Goiania incident.

Economic Mitigation. The concerted actions of the Goiania Commercial and Industrial Council provide two excellent examples, one an emergency or short-term response and the other a calculated medium-term response, of economic mitigation measures applied to counter the economic impacts of the Goiania accident. The short-term response, mentioned earlier, was the utilization of the Council to establish united front among producers in opposition to the economic manipulation of the wholesalers and other commercial brokers who had intentionally, and successfully, used the "potential threat" of radiation contamination to "squeeze" the producer into as much as a 50% reduction in sales price. The efforts of this organization involved informing the producers of the fact that the wholesalers were continuing to sell their products in national markets at the normal price and had been reaping a major profit off of the ignorance of the producer. For certain products, this was an almost immediate success. Within a week or ten days some of the producers were getting prices very near (within 10%) of normal for that season.

A more difficult problem facing the commercial sector of the Goiania economy was the more subtle and insidious efforts of other states and major producing areas to use the Goiania accident as a means of manipulating the position of Goiania products in national

markets. In order to counter these efforts, the Goiania Commercial and Industrial Council created a "Cultural Information Program," whose specific intent was to counter the negative commercial consequences of the radiation contamination accident. The organization felt that the problem they were dealing with was one of "lack of accurate and credible information." Thus, the initial approach taken by this group was to design an information campaign which, they felt, would "set the record straight" with respect to the actual causes, distribution, and residual risk imposed by the contamination. In order to achieve these objectives, they decided that they must first establish a credible team of international experts who would conduct their own independent review of the actions of CNEN, and provide a "guarantee" that the cleanup had been thorough and complete. Then, by disseminating this information in the media, they expected that demand for Goiania products would return to prior levels and the economic impacts of the accident could be terminated. Several factors prevented this effort from being completed. First, since every decision had to be approved by the members of the executive board of this association, making the decision to go through with the action took many weeks. Second, the debate over whether or not this would be an effective action or not continued even after the original decision was achieved. Third, the costs of the contemplated actions (bringing over and maintaining all of these experts) posed a significant burden on the membership. Finally, about the time they were finally ready to initiate action, the CNEN announced that their cleanup actions had been complete and declared the city "free of contamination." It was at this point that the organization had to reevaluate their decision to essentially "re-open" the case and "risk" the possibility that the new experts would actually discover areas of the city that continued to be contaminated and would thus require additional cleanup action. They knew that if they really did bring in experts who were qualified to certify the safety of the city, that there was a serious risk that they might find such sources of radiation and that this would have been entirely counter to the commercial interests of its members. The "program" was abruptly terminated.

Social Mitigation. Several new organizations were formed to counter the negative social impacts of the Goiania Accident. First, the Goiania Victims Association, a formal quasi-political organization, was formed to provide a forum for victims of the cesium accident to voice their grievances and to work toward affixing responsibility or blame, and to maintain political pressure on legal authorities to assign responsibility for the accident. Second, a formal, well-funded, foundation called the Leide das Nieves

Foundation was formed to continue to treat and maintain the victims of the accident, to sponsor and manage research activities in support of the victims, and to provide a point of contact for any additional new victims that are ultimately identified. Third, the State Health Agency has accepted the offer of the International Cancer Registry to establish Goiania as one of its long-term cancer monitoring stations; this action assures not only that the long-term risks of the radiation will be monitored by the most reliable source in the world (a source of some security) but also promises to sustain interest in the effect of the accident for at least the next 50 years (not necessarily a positive outcome). Fourth, the Nucleo de Acompanhamento do Acidente Radiologico (NUAC) da Universidade Federal de Goias, an interdepartmental university association, was formed to continue studies of the causes and effects of the Goiania accident.

While little can be said about concerted efforts to deal with the media, a number of individual responses do provide a basis for recommendations. First, the needs of the media for timely information must be anticipated prior to the occurrence of a radiological accident. Prearranged lines of communication between responsible authorities and the media must be easily accessible so that rapid dissemination of accurate information, and accurate interpretation of that information, will be facilitated. Any similar accident, for example, will be extremely "newsworthy" and the power of the media to influence public opinion, and channel public response, was obvious in the Goiania case. The media, in this instance, was responsible to a large extent for the extreme burden the public unnecessarily put on social and health care services. An analysis of the role of the media will be an important aspect of future work on the Goiania Model.

What was very clear from the public response to the accident is that established social organizations were unable to deal effectively with the social ramifications of the accident and that a great many public needs were created that went unsatisfied in the aftermath of the accident. The institutions that were responsible for the day-to-day regulation of radiological materials in Brazil were not prepared for acute crisis management. In addition, it was never clear to which of the existing social institutions one would apply for assistance, and it remains unclear which agencies should have been responsible for the management of the crisis. For example, it has fallen to the local health agency to diffuse the stigma effects of the accident though they were, and to some extent remain, ill-equipped to deal with the kinds of issues that have arisen as a direct consequence of the accident. They have been expending enormous amounts of time and energy to help

individual citizens overcome the effects of stigma and to counter citizen concern that hospitals, clinics, and other medical facilities may remain contaminated.

Political Mitigation. As noted in the earlier report, progress continues toward reorganization of CNEN. It is expected that this reorganization will involve separating the functions of the agency along lines already established in the U.S. In fact, most of the documentation and regulatory approaches utilized in Brazil have been lifted directly from policy manuals used in the United States. Thus, it is quite likely that the CNEN will be reorganized into groups whose responsibilities will roughly correlate with the American organizations (e.g., FEMA, NRC, EPA). There appears to be little doubt that a new entity will be created to deal with equipment surveillance (an agreement being reached between the Ministries of Health and Labor) and that a new division of technical laboratories will be created. With an initial investment of over US$ 700,000 in new monitoring equipment, laboratories are expected to be located in Curitiba, Sao Paulo, Belo Horizonte, Recife, Brasilia, Belem and Fortaleza--Goiania being a notable exclusion from the list.

The decision of who will ultimately be responsible for assuring that a similar accident does not occur in the future has not been taken. It is expected, however, that the results of the legal inquiry into the accident will have an important bearing on how these agencies are ultimately reconfigured. This inquiry is due to be completed by mid-June, 1988. In all likelihood, the doctor and three associates who owned and abandoned the clinic and the cancer therapy device will be indicted. The actions of the director of CNEN are also being investigated at this time but it is unlikely that he or the director of the State Health Agency (OSEGO) will be indicted.

SUMMARY

The Goiania incident occurred in a cosmopolitan city of more than one million well-educated, urban, sophisticated resident. Thus, it is important to emphasize the danger in assuming that these impacts are somehow "culture-specific" phenomena. Some of the factors that promoted the spread of the problem, such as the unchecked manipulation and sensationalization by the media, the "outside experts" problem, and so on, apply more to Brazil than to the United States. However, it is important to understand that in many

other ways the risks are greater in United States -- information travels faster, has a greater impact on a larger number of people, and can affect national commodity markets in a matter of minutes. Moreover, as a population, we can hardly claim a much greater understanding of radioactive contamination. Finally, we must recognize in the United States that a technical risk assessment can be absolutely accurate and yet fail to anticipate, or protect against, the potentially devastating impacts of social interpretations of an accident event.

The intent of this paper was to demonstrate the importance of perceived risks in predicting potential socioeconomic impacts from a nuclear-related accident and to demonstrate that the social channels, political institutions, and economic mechanisms through which socioeconomic impacts are distributed are of profound importance to the control and containment of potential nuclear-related socioeconomic impacts in the United States.

The lessons to be learned from the Goiania event apply to both low- and high-level radioactive waste siting decisions, to reactor siting decisions, to radioactive materials transport, to medical and technical uses of radioactive substances, and, in fact, to accidents involving any number of other materials which can cause injury or death through what the public perceives to be mysterious processes.

Any scenario that postulates the release (or the potential release) of a relatively small amount of radiation to the environment will entail a wide array of consequences. In any such scenario, the radiation exposure itself will be an obvious problem both in terms of physical risk and in terms of the socioeconomic impacts on the exposed persons and communities. As the Goiania case study illustrates, however, the aggregate impacts of the exposure itself will likely be minor when compared with the socioeconomic consequences of people's perceptions of the risks involved, and their reactions to those perceptions.

It should be noted that the Goiania incident continues to unfold. Additional research is need to record longer-term effects of the incident to establish which effects persist and which do not, and the reasons behind these distinctions.

There are two principal benefits from the Goiania incident research. First, and most important, is the value of demonstrating linkages. Unlike the work conducted in both Washington and Nevada, which has been focused on the analysis of theoretical, logical, or more remotely possible real or perceived risk scenarios, the Goiania event provides: (1) a concrete set of actual direct consequences; (2) a wide array of very serious (many of which have yet to be considered in the literature) indirect and/or secondary impacts; and, most importantly, (3) the actual linkages between the primary and indirect consequences. These are precisely the elements that are most likely to convince individuals or organizations (e.g., NRC) that remain somewhat "skeptical" of the potential social and economic impacts to be experienced by Nevada in the event of a "technically" minor or relatively unrelated radiological accident.

The second aspect of the research of particular value to the state of Nevada is in the area of impact mitigation. Given the fact that Nevada is likely to continue to be the primary site for United States nuclear weapons testing, it will also continue to be subject to a wide range of potentially detrimental consequences of technical and perceived risks. It is therefore important that the state be aware of and be prepared to take appropriate independent mitigative actions to protect the interests of its residents. Thus, an understanding of the reasoning behind, and consequences of, mitigative actions taken by the State of Goias in response to the Goiania accident should prove of considerable future value regardless of the fate of the repository issue. These actions pertain to issues such as compensation strategies, emergency response plans, and unanticipated impact variables, etc., and suggest important strategic perspectives to the state of Nevada. The effort by local and federal authorities to control adverse social and economic effects will be of similar interest and value to the state.