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REACTOR SITING CRITERIA AND EVACUATION

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Consequences of a Serious Accident

One of the fallacies in the current evacuation planning and testing program in the U.S. is the belief that a properly implemented and executed plan will protect the people. This is a fallacy because today's evacuation plans are not designed to cover the full range of potential accidents at an operating reactor. The U.S. Nuclear Regulatory Commission (NRC) has never determined the consequences of a Class 9 accident with breach of containment at nuclear reactor sites. A Class 9 accident involves a sequence of successive failures more severe than those postulated as the design basis for reactor protective systems and engineered safety features. (The NRC staff concluded that Three Mile Island was a Class 9 accident.) The probability of such an accident has also not yet been determined by the NRC.

The location of the Zion, Illinois, in the most densely populated area of the midwest United States, is a case in point of extremely poor reactor siting. Only 40 miles north of Chicago and 40 miles south of Milwaukee, the Zion Station presents the potential for enormous consequences. Based on 1970 census data, 16 cities with a population of over one-million lie within 30 miles of the Zion Station, and 39 cities with seven million people lie within 50 miles.

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A nuclear power plant contains several tons of radioactive material, much of which is gaseous and, if released, could be borne away by the wind. The consequences of this type of accident have been detailed by the NRC in WASH-740 and its update the Brookhaven Report, and in the Reactor Safety Study (WASH-1400).

The Reactor Safety Study, also known as the Rasmussen Report, was published by the NRC in October 1975. The NRC has since repudiated the probability estimates contained in WASH-1400. However, it continues to stand behind the study's estimate that a core meltdown with breach of containment could kill 48,000 people from acute radiation sickness and radiation-induced cancers, cause another 285,000 non-fatal radiation injuries, give rise to 5,100 genetic defects in the first generation born after the accident, result in \$14 billion in property damage, and contaminate 3,200 square miles to such high levels of radioactivity that it would remain uninhabitable for a century.

The Reactor Safety Study also described some of the procedures needed to decontaminate areas affected by an accident. Removal of radioactive material from hard surfaces could require replacement of walls and pavements or resurfacing of pavements. Decontamination of land areas could require removal and disposal (probably burial) of vegetation and surface soil or deep plowing. It is inconceivable that such measures would be feasible for a significant portion of the metropolitan Chicago area.

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The updated WASH-740, done by Brookhaven National Laboratories in 1964-65, states that "most of the damage is done by activity released in the first two hours. As a result there (are) only about two or three hours available for evasive purposes. Close in there (is) very little that could be done since doses (are) higher and received sooner. Mr. Smith added that the population involved is large and would make evasive measures difficult. Dr. Winsche noted that ~~shelter~~ might be helpful, but Mr. Downes said that this was not the case."

As serious as these predicted consequences are, there are a number of reasons why the actual consequences could be far worse in the case of Zion. One of the most significant is that the number of casualties described above assumes that a massive evacuation has taken place within hours of the accident. The Reactor Safety Study calculations are based on the assumption that all people within five miles of the reactor could be evacuated in a few hours along with most of the people downwind for a distance of 25 miles within a 45-degree sector. This evacuation model is clearly not applicable to the Zion site. Moreover the Reactor Safety Study itself (Appendix VI, page 11-6) stated that for New York and other metropolitan areas, "there is no presumption that the population... could be moved in less than one week." Therefore, the consequences of a catastrophic accident at Zion, with a population over one million within 30 miles, would be significantly worse than the consequences reported by WASH-1400.

The NRC can no longer hide behind the fiction that an accident resulting in releases of radiation to the public can never occur. To the extent that WASH-1400 was relied on to back such an assertion, it can no longer be used. On January 18, 1979, its policy statement repudiating WASH-1400, the NRC stated:

"The Commission does not regard as reliable the Reactor Safety Study's numerical estimates of the overall risk of reactor accidents."

The NRC acted none too soon in disclaiming reliance on the Reactor Safety Study. The accident at Three Mile Island less than three months later proved baseless the claim that all significant accident sequences had been identified and protected against.

The Zion reactors represent a clear and present danger to the health and safety and well being of millions of people. Under these circumstances, it is necessary for the NRC to address itself to the question of whether the Zion site is suitable as the location for two nuclear power reactors.

Radiation Exposure

If radiation were released in a Zion Station accident, the public downwind of the reactor site would be subject to radiation exposure from the following:

- Penetrating radiation from a passing cloud of airborne radioactive material.
- Penetrating radiation from radioactive material deposited by the cloud on the ground and other surfaces.
- Exposure from the inhalation of radioactive material.
- Exposure from ingestion of contaminated crops, milk, water.

Thyroid Blocking with Potassium Iodide

The use of potassium iodide (KI) to block the thyroid gland from absorbing hazardous radioiodine that might be released in a nuclear plant accident is a recognized protective measure. KI is the only FDA-approved drug for this purpose. On February 22, 1980, FDA published notice in the Federal Register, officially notifying the public, state, local governments and the nuclear industry of the availability of the approved drug for use in the radiological accidents at nuclear power plants, that it requires no prescription, and it is available over the counter. In May 1980, the Wallace Laboratories reported a two-batch supply available for approved use.

Two major federal investigations, the Presidential Commission and the Special Inquiry Group of the NRC, made strong recommendations to have KI readily available and prearrangements for its distribution and use at the time of an accident at a nuclear facility. The Special Inquiry Group also recommended that the NRC establish criteria for storage and distribution of a thyroid blocking agent, that the nuclear facilities fund its purchase and storage, and that it be available for the general population in the vicinity of nuclear plants.

In March 1980, Sandia Laboratories completed a study for the NRC suggesting that KI distribution be limited to nuclear site personnel, offsite emergency response personnel and persons in offsite institutions within about ten miles (i.e. hospitals, prisons) where immediate evacuation might be infeasible or very difficult.

Shortly thereafter, the NRC staff recommended against distribution of KI to the general public until further FDA studies on adverse medical effects.

In commenting on the NRC staff position, the FEMA Radiological Emergency Preparedness Division Staff said that NRC's policy of excluding the general population at risk could be publicly or legally challenged. FEMA pointed out that the country needs an official, fully coordinated Federal policy and guidance on the use of the drug and that it looks to the FDA to develop this policy and guidance.

Emergency Planning Zones and Accident Notification

Federal rules require utility notification of state and local authorities within 15 minutes of identification of any potential, developing or actual emergency; notification of 100 percent of the public inside a 5-mile radius of the nuclear plant within 15 minutes; and a nuclear facility near-site emergency operating facility about one mile from the nuclear power plant.

A typical alert system, comprising sirens and tone alert radios, ranges from \$500,000 to \$750,000 according to the NRC. For a site with a relatively high population within the ten mile emergency planning zone (EPZ), FEMA estimates an initial cost of \$2-million for implementation of new evacuation criteria.

Illinois is planning for a remote radiological monitoring system, called a ring system. The estimated cost of \$1.75 to \$2-million

per site.. The State and local tax and fee structure averages about \$25 million per year for a \$1 billion investment, such as a nuclear power plant. When compared to these tax and investment figures, the cost of evacuation implementation is relatively small -- says FEMA.

IS A TEN MILE EPZ ADEQUATE?

A NRC/FEMA task force selected ten miles as the area for evacuation because it said that, even in the worst accident, it was the maximum area for public exposure of radioactivity. The threshold dose at which some people would die is 200 rem. At a dose of 400 rem, half of the exposed people would die. A rem is a measure of radiation exposure that indicates degree of biological damage.

The ten mile radius has come under criticism. Dr. Jan Beyea, senior scientist for the National Audubon Society, warns: "There are weather conditions, such as rain, in which one could get early fatalities out to 20 or 30 miles."

Even the conservative Reactor Safety Study (Vol. VI, pages 11-29,30) states that "Within 25 miles of the reactor, the doses would be sufficiently large to cause early mortalities or morbidities, so that individual doses must be considered. The Reactor Safety Study states that with ground contamination, relocation of all people within 25 miles is assumed in seven days, and, if it is raining, in two days.

Focus on Immediate Fatalities

The NRC/EPA decided to set the EPZ at ten miles and concentrate on reducing immediate deaths. Of this, Dr. Beyea says: "The NRC has concentrated on protecting against early fatalities and they're not paying proper attention to mitigating consequences of other, more long term effects. Beyea believes that even beyond 50 miles, thousands of people would get doses of ten rem or less for each close-in person affected by large doses. He said the long term effects in a nuclear accident are the cancer deaths and thyroid cancer cases that could afflict people hundreds of miles downwind from a reactor who are exposed to low doses of radiation following a large nuclear accident.

Time Factors Associated with Radioactivity Releases

The Reactor Safety Study indicates that major releases may begin the the range of one-half hour to as much as 30 hours after the initiating event and that the duration of the releases may range from one-half hour to several days with the major portion of the release occurring well within the first day. (WASH-1400, Appendix VI, page:2-5). The time between awareness of a core meltdown and the release of material from the containment building is estimated at onser two hours in WASH-1400.

NRC Guidelines for a General Emergency

A nuclear power plant can release up to 1000 curies of iodine-131 and 10-million curies of xenon-133 before there is any consideration of evacuation of the general public. If more than these amounts are released, and if the effluent monitors detect levels of 1 rem per hour to the body or 5 rem per hour to the thyroid^{at} the site boundary under actual meteorological conditions -- then the NRC recommends that responsible authorities consider precautionary evacuation only within about 2 miles of the site boundaries.

If "these levels are exceeded by a factor of 10 or projected to last for 10 hours (i.e. 10 rem/hr. to the body or 50 rem/hr to the thyroid), then the NRC recommends that authorities consider extending the evacuation area to 5 miles.

In a core meltdown situation, where significant releases are not yet in the containment atmosphere, the NRC advises a 2 mile precautionary evacuation. It suggests that authorities consider a 5 mile downwind evacuation (45 deg. to 90 deg. sector) if large amounts of fission products are in the containment atmosphere. The NRC recommends sheltering in other parts of the plume exposure EPZ under this circumstance.

For accidents where significant releases are not yet taking place and containment failure leading to a direct atmospheric release

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is likely, but not imminent, and large amounts of fission products in addition to noble gases are in the containment atmosphere, the NRC recommends precautionary evacuation to 5 miles and in a 45-90 degree 10 mile sector downwind.

If containment failure is judged imminent and there are large amounts of fission products other than noble gases in the containment atmosphere, the NRC advises shelter for those areas where evacuation cannot be completed before the radioactivity reaches that location.

These NRC guidelines for emergency actions are called "Protective Action Guides (PAGs). They are detailed in the NRC's "Draft Emergency Action Level Guidelines for Nuclear Power Plants" (NUREG-0610), September 1979 and are based on U.S. Environmental Protection Agency (EPA) recommendations.

Sheltering as a Means of Protection

Since most people beyond 5 miles of a nuclear reactor accident will probably be sheltered and not evacuated in adherence to NRC guidelines, it would certainly behoove us to take a close look at the adequacy of sheltering as a protection against radiation and radioactivity.

FEMA, in its 1980 report to the President, gives sheltering faint praise. It says, "Sheltering as a protective measure strategy needs more practical Federal guidance for State and local officials." According to FEMA, the only sheltering guidance that the Federal guidance can now offer are three research reports (see references).

FLMA complains that "There is no official Federal guidance on sheltering for nuclear power plant accidents suitable for practical use by State and local officials."

However, we can get a few clues to the nature of sheltering from WASH-1400 and an International Atomic Energy document. Their discussions of sheltering advise:

- Close all doors and windows.
- Turn off all air ventilation systems.
- Go to the basement or a centrally located room without windows. If you have no rooms without windows, sit in corners and other places shaded from direct sunlight. Gamma rays come through windows with very little dilution.
- Put out any fires in heaters or fireplaces, close heater and chimney damper.
- Put pregnant women and children in rooms with greater shielding and airtightness.
- Place layers of moist newspapers or cloths in the chinks of doors and windows to reduce inhalation doses by a factor of 10.
- Breathe filtered air. If you do not have a suitable respirator or gas mask, cover nostrils with 8 layers of handkerchiefs or 2 layers of towels. Remember that infants cannot tolerate such a filter over the nose and mouth.
- When the radioactive plume has passed, quickly open windows and doors to ventilate your house of any contaminated air to minimize inhalation of radionuclides.

Role of FEMA in Emergency Planning

FEMA is conducting studies of evacuation times around 12 nuclear power plants with the highest population density, or other special problems, developing standard scenarios for exercising emergency plans and preparing guidance for the evacuation of joint exercises of utility and State and local emergency plans.

In their report to the President, FEMA found many deficiencies in emergency planning. Their findings should alert Zion area officials to important evacuation problems. For example FEMA reported:

- that no formal Federal emergency plan exists in current regulations;
- that service institutions such as hospitals have not oriented their professional training towards large scale evacuation and radiation treatment;
- that the preparedness of State and local governments as far as radiological assessment technology, monitoring instruments, and the systematic and coordinated organization of personnel and resources, is generally inadequate;
- that Federal leadership is needed to plan evacuation, sheltering and the uses and distribution of potassium iodide to protect the thyroid.

Financial Considerations in Evacuation Planning

FEMA's discussion of financial considerations in emergency action planning deserves attention:

"State and local government costs for implementation of the new evaluation criteria is about \$1 million one time per site in a typical State. The 15 minute

alerting and notification system is a large portion of the total cost. For sites with relatively high population within the 10 mile EPZ, initial cost could reach \$2 million or more. Recurring costs of 10 percent of these amounts per year could be expected."

According to FEMA, "There is little evidence that a funding mechanism for emergency preparedness around nuclear power plants exists." Studies performed by the Presidential Commission on Three Mile Island, the NRC Special Inquiry Group, the National Academy of Public Administration, and the NRC and FEMA staffs, recommend that a major part of the cost of preparedness should be paid for by the utilities. They say that cost of preparedness should be incorporated into the cost of electricity from nuclear power plants.

All current FEMA emergency plan reviews are based on the 10 mile EPZ for the radioactive plume exposure pathway. Planning for the 50 mile ingestion exposure pathway has yet to be implemented. The Zion site, operated by Commonwealth Edison, has had two operating units since 1973. This site affects Lake County for the 10 mile EPZ with a population of 165,000.

Illinois is developing "exercise scenarios". The first trial scenario took place at Dresden nuclear station on October 29, 1980. About 180 school children from nearby Channahon were evacuated 25 miles downwind by bus to Bolingbrook. No one mentioned that the children would have traveled 25 miles enveloped in the radioactive plume they were supposedly trying to escape. FEMA announced that "The state demonstrated solid capability to protect the public

in the event of an accident at the Dresden facility."

The Zion site is one of the 12 sites to be evaluated, but FEMA does not have the financial resources to do so in FY 1980. However, an assessment of evacuation times around the Zion Station is being done by Alan M. Voorhees and Associates of McLean, Virginia.

The director of Illinois Emergency Services and Disaster Agency, E. Erie Jones, says that an emergency operations center in Lake County is necessary to protect those planning the evacuation from radiation and radioactive fallout. The cost of such a facility is estimated at 600,000 to \$700,000. Jones said the cost should be borne by the County and paid from local taxes from the Zion nuclear station.

The potential for catastrophe at Zion is unlimited. The threat of physical and financial disaster could have been avoided entirely. (See attached article "The Zion Incident" for detailed scenario of postulated accident at Zion, authored by this writer.)

Since Three Mile Island, it has become increasingly evident that a highly populated area - located next to Illinois' most valuable natural resource, Lake Michigan - is no place to site a nuclear reactor.

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