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STATEMENT OF

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ON BEHALF OF
THE NATURAL RESOURCES DEFENSE COUNCIL, INC.

BEFORE THE
SUBCOMMITTEE ON ENERGY CONSERVATION AND POWER
OF THE
COMMITTEE ON ENERGY AND COMMERCE
U.S. HOUSE OF REPRESENTATIVES

CONCERNING THE
IMPLICATIONS OF THE
CHERNOBYL DISASTER
FOR DOE PRODUCTION REACTORS

MAY 7, 1986
(Revised)

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My name is Thomas B. Cochran. I am a Senior Staff Scientist with the Natural Resources Defense Council (NRDC), and I hold a Ph.D. in physics from Vanderbilt University. I was a member of the Department of Energy's (DOE's) Energy Research Advisory Board from 1978 to 1982 and a member of the Nuclear Regulatory Commission's (NRC's) Advisory Panel for the Decontamination of the Three Mile Island (TMI) Unit 2 from 1980 to 1986. For over a decade, NRDC has been actively concerned about the health and environmental hazards posed by DOE's nuclear weapons production facilities.

I am pleased to have been invited here to testify before the Subcommittee on the implications of the Chernobyl disaster on the continued operation of the plutonium production reactors operated by DOE.

The disaster at Chernobyl has renewed debate about the safety of nuclear reactors in the United States. American nuclear industry and government officials have been quick to point out the differences between U.S. and Soviet reactor design and regulation. Unlike most Soviet reactors, most U.S. commercial power plants are encased in sealed containment structures designed to prevent the release of radioactive materials into the environment. The one exception is the Fort St. Vrain demonstration reactor, a high-temperature (helium) gas-cooled reactor (HTGR), in Platteville, Colorado. Also in the U.S. most large reactors are subjected to independent control and public scrutiny through the NRC. The sole exceptions are five large nuclear reactors owned by the DOE and operated to produce plutonium and tritium for nuclear weapons: the N-Reactor at the Hanford Reservation and the P, K, C and L-Reactors at the Savannah River Plant (SRP). Of them, the 22-year-old N-Reactor at DOE's Hanford Reservation near Richland, Washington is the most similar to the stricken Soviet nuclear power plant. Both the Chernobyl and the N-Reactor are light water-cooled graphite-moderated channel-type thermal reactors. Unlike the U.S. light water power reactors, the water used as the primary coolant in these reactors is pumped through a manifold where it is directed under pressure through more than 1000 individual pressure tubes which also house the uranium fuel. The tubes are located in channels bored through the graphite. Hence these reactors are often referred to as "channel-type" or "pressure tube" as opposed to "pressure vessel" reactors. Because failure of a single tube does not endanger the full core as would be the case with the rupture of a pressure vessel or large pipe break, this multicircuit feature is often offered as a safety advantage relative to light water (pressure vessel) reactors. In fact, one Soviet nuclear expert claimed "a serious loss-of-coolant accident [in an RBMK reactor] is practically impossible" (B.A. Semenov, "Nuclear Power in the Soviet Union", IAEA Bulletin, 25, June 1983, p. 51). I am sure he wishes he had never made this claim.

The Chernobyl Unit 4 reactor is, or more aptly was, what the Soviets call an RBMK-1000 type reactor. RBMK is the Soviet nomenclature for "high power channel-type reactor". The 1000 refers to its rated power level in megawatts (electric) (Mw_e). The N-reactor, rated at 4080 megawatt (thermal) (Mw_t) is somewhat larger than the 3200 Mw_t Chernobyl RBMK-1000. Both are comprised of a set of fuel channels passing through a stack of interconnected graphite bricks which serve as the neutron moderator and reflector. The channels are horizontal in the N-reactor and vertical at Chernobyl. The graphite structures are huge. At Chernobyl the graphite is shaped into a vertical cylinder 11.8 meters (m) in diameter and 7 m high. It is this graphite, weighing some 2000 metric tons, that apparently fueled the intense fire. The core of the N-Reactor is about 60 percent larger with a volume measuring 12 m x 10 m x 10 m. It is surrounded by a graphite reflector 0.5 m thick in the front and rear and 1.2 m on the other sides.

At a more detailed level, the designs of the N-Reactor and Chernobyl are quite different. The Chernobyl reactor has only one coolant loop, much like the U.S. boiling water reactors (BWRs); in contrast the N-Reactor has a secondary loop similar to the U.S. pressurized water reactors (PWRs). The N-Reactor's primary coolant, therefore, operates at a higher pressure and temperature. The fuel in the Chernobyl reactor is uranium oxide (UO_2) enriched to 1.8 percent U-235, whereas the N-Reactor fuel is uranium metal enriched to about 1 percent U-235. As a consequence, the N-Reactor utilizes more uranium, and its fuel will melt at a much lower temperature.

There may be significant differences between the safety systems of the two reactors as well. The N-Reactor utilizes a helium gas blanket as added protection against a graphite fire, and has a second independent, diverse control system for shutting down the reactor during an emergency. It also has a water spray system for cooling the graphite and its shield in the event of a loss of primary coolant accident. It is not known to what extent the Chernobyl reactor shares these important safety features.

The four DOE production reactors located at SRP are cooled and moderated with heavy water. These reactors, and a fifth on standby, were constructed between 1950 and 1955 and are among the oldest reactors now operating in the United States. While one of them has achieved a power level of 2915 Mw_t, they typically operate at 2100 Mw_t during plutonium production runs and 2400 Mw_t when dedicated to tritium production. At these levels they are slightly smaller than the size of the TMI reactors.

Physically, the SRP reactors bear little resemblance to the graphite designs at Hanford and Chernobyl. The reactor core is contained in a steel reactor vessel similar in many respects to U.S. light water power reactors. Since the SRP reactors are not used to produce power, the primary coolant operates at a much lower temperature and pressure. This safety advantage is offset to some extent by the fact that these reactors are not aging gracefully. The C-reactor, for example, is presently undergoing repair of a twelve inch through-wall crack in the reactor vessel. (Nucleonics Week, 17 April 1986, p. 3.)

While much remains to be learned about the Chernobyl design and the sequence of events during the accident, it would be a mistake to concentrate solely on technical differences in the designs. Large nuclear reactors, of widely divergent designs, share one common feature: they can suffer loss of coolant or other accidents resulting in overheating or melting of their fuel and the release of huge amounts of radioactive materials. In the U.S., the Fermi experimental fast breeder reactor near Detroit suffered a small partial core melt in 1966; and at Three Mile Island in 1979, a third of the nuclear core of a PWR melted. In the latter case, large emissions of deadly radioactivity were prevented by the integrity of the reactor vessel and a massive sealed concrete containment dome.

Thus the most important lesson to be learned from Chernobyl is not that U.S. reactors are better because they have more whistles and bells to prevent a core-melt, but that a core melt can happen. It can happen anywhere, anytime, in any large operating reactor in the U.S. or abroad. The lesson we should bring home from the Soviet Union is that if these reactors are to operate at all, they must have robust containment.

The vintage DOE reactors unfortunately do not have containment systems, but rely on so-called "confinement" systems, which are little more than ordinary factory buildings surrounding the reactor. Unlike a containment system, these buildings are not constructed to withstand the high pressures that could be generated by a hydrogen explosion or by hot gases. In the event of an accident -- assuming the building remains intact -- radioactive emissions from the core are vented directly into the atmosphere through a series of filters. These filters will trap most of the organic iodine and radioactive particulates, but they will not prevent the release of clouds of radioactive xenon and krypton gases and elemental iodine. If overwhelmed or disabled by smoke, steam, or high temperatures, they would also permit the release of large amounts of radioactive particulates, including cesium and a variety of other isotopes detected following the Chernobyl disaster.

In 1980, DOE analyzed the radiological impact of a hypothetical loss of coolant accident for the N-Reactor (N-Reactor Updated Safety Analysis Report, UNI-M-90, March 1980, Vol. 7, Section 15.6.6). The severity of this hypothetical accident is more like the event at TMI-2 than at Chernobyl. The postulated scenario assumes that the emergency graphite and shield cooling system (GSCS) functions properly to cool the fuel, limit the extent of fuel failure, and prevent an explosion and graphite fire, such as occurred at Chernobyl. Under these assumptions approximately one-third of the fuel melts, comparable to what happened at TMI-2.

Because the GSCS is assumed to operate as desired, much of the radioactivity is rained out or plated out in the reactor building before reaching the confinement filters. Even so, about

100 million curies of radioactive noble gases and iodine are projected to be released into the environment, about 10 times the amount thought to have been released at TMI.

The N-Reactor, as well as the SRP reactors, share a common virtue in that all are located on huge Government reservations. The reactors are typically 5 miles or more distant from the site boundary. Thus, even though the amount of radioactivity released in this hypothetical accident would be higher than at TMI-2, the off site radiation levels would be comparable. In sum, if the GSCS operates effectively, a Chernobyl-like disaster most likely would be avoided.

If the emergency system fails to operate, however, a graphite fire and perhaps even a hydrogen explosion, appears highly likely. The confinement filter system would be overpowered resulting in large off-site radiation doses. Moreover, there are some 13,000 people employed at Hanford. As at Chernobyl, some of these employees likely would be exposed to fatal levels of radiation.

The DOE has also examined the consequences of a loss of coolant accident in its heavy water reactors at SRP (DOE, Final EIS, L-Reactor Operations, SRP, DOE/EIS-0108, Vol. 1, p. 4-64). There are some 15,000 workers at the SRP site and over 100,000 people live within 25 miles. A postulated accident resulting in 10 percent core-melt at the L-reactor would result at the site boundary in a mean whole body dose of 0.3 rem and a mean thyroid dose of 2 rem; the "peak" values would be 2 rems whole body and 12 rems to the thyroid. A full core melt would be 10 times worse, resulting at the site boundary in a mean whole body dose of 3 rem and a mean thyroid dose of 20 rem; the "peak" values would be 20 rems to the whole body and 120 rems to the thyroid. The site boundary is about 9 miles from the L-reactor. The doses to workers on site nearer the reactor would be much higher and could be lethal. This would be a severe accident by any standard.

In 1982, the Natural Resources Defense Council, the Energy Research Foundation and other citizen groups, and the State of South Carolina won a lawsuit which forced the DOE to prepare an unprecedented environmental impact statement on one of its production reactors. The suit challenged DOE's plans to renovate and restart the L-Reactor at SRP, which had been mothballed for over a decade. While most of the attention focussed upon discharges of hazardous chemical wastes and heated water, the issue of the safety of the reactors and lack of containment structures was raised. DOE brushed aside serious core melt accidents as "incredible". It gave scant attention to adding containment to the L-Reactor. The DOE questioned the technical feasibility of making the L-Reactor leak-proof. It indicated that the price of $400-900 million was too high, although this figure would present just 10-20% of the cost of a replacement reactor today. This line of reasoning was surely applied to the RBMK reactors, and undoubtedly led to a decision that the Soviets must now dearly regret.

The Department of Energy can get away without containment for all its production reactors, because its reactors do not have to meet the same safety requirements applied by the NRC to commercial plants. The DOE reactors at SRP clearly do not meet many of NRC's 10 CFR 100 regulatory requirements. I also seriously question whether the confinement system at the N-Reactor could pass muster under NRC requirements. As in the Soviet Union, these U.S. Government reactors are self-regulated and their operations remain shrouded in secrecy. Thus, DOE's persistent claims as to the safety of its facilities are never really tested.

We believe that Congress should require that DOE reactors be licensed by the NRC. Such licensing would not interfere with legitimate national security needs, since the NRC already has procedures in place to protect sensitive information. While we recognize the shortcomings of the NRC, licensing of DOE reactors by the Commission would help to assure the American public that all large nuclear reactors in this country are subject to the same outside scrutiny and control. In the wake of Chernobyl, we can afford and should accept nothing less.