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UNRESTRICTED DATA

NEW CHALLENGES TO THE COLD WAR SECRECY REGIME, 1964–1978

> Where is the alternative to nuclear *laissez-faire* and nuclear monopoly? Our inability to find the answer to that question, in full awareness of the risk of not finding it and in spite of our search for it, constitutes the tragedy of our nuclear policy.
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> HANS MORGENTHAU, 1964[1]

Though the regime of nuclear secrecy established in the 1950s is still with us, some of its harder edges and extremes have become muted over time. Its persistence in the face of challenges and contradictions has been impressive, enabled by its pretensions of mastery over both the hopeful and fearful aspects of nuclear technology and the absence of strong competing alternatives. It had become so embedded in the fabric of American bureaucracy, and the American security mindset, that it is difficult to imagine anything different at this point.

Challenges and contradictions did arise, however, though they were slow to gain traction. While the Soviet Union had built its own nuclear arsenal by the 1950s and the United States had begun working to distribute the fruits of "peaceful" nuclear technology, in many ways the United States still retained a de facto monopoly over nuclear knowledge in the non-Soviet sphere. The US government was still the largest funder of nuclear technology in the "free world," and anyone who wanted to have a hope at competing in that sector needed to pass through US institutions, which meant security clearances and complicity. Even the opening up of work to private industry was largely a controlled activity, with industry playing a submissive role to government declassification and

subsidies. And while parallel work was being done in the USSR, the Soviets were not in the habit of spreading their own produced knowledge and work too liberally, either.[2]

But the de facto monopoly was beginning to loosen. The number of actors, both domestically and abroad, was starting to multiply. And as nuclear technology was becoming more common, the line between the military and civilian threatened to blur in ways US experts found alarming. What had once seemed controlled and relatively safe threatened to unravel in ways that could be catastrophic.

7.1 THE CENTRIFUGE CONUNDRUM

The de facto US monopoly on innovation in nuclear technology lasted for the first decade after the Manhattan Project. Even after the British had joined the "nuclear club" in 1952, the United States remained the primary innovator of new nuclear technology, spending billions of dollars per year on the massive, sprawling industry controlled by the AEC. Other nations who were interested in doing nuclear research or sharing the fruits of said research would most likely need US assistance to make significant strides. But the US, from Eisenhower's "Atoms for Peace" program onward, was willing to grant that assistance.

Starting in 1955, the US also began to enter into dozens of bilateral agreements, most for research but some also for power programs, with friendly or neutral nations around the world. It also encouraged the development of the European Atomic Energy Committee (Euratom), meant to unite the once fractious European allied states around technical cooperation on nuclear issues, and supported the growth of the International Atomic Energy Agency (IAEA) in the late 1950s as a promoter and eventual "watch dog" on peaceful nuclear matters. US policymakers were not truly altruistic on this issue. Rather, they believed that peaceful atomic energy could be a "carrot" that would serve US goals abroad and that encouraging international dependence on the US would prevent such countries from developing too much indigenous nuclear knowledge on their own. If these nations wanted nuclear reactors, it would be better for the US to provide them, because it would allow the US to set the terms and monitor the use of the reactors.[3]

But the US monopoly was largely a function of having gotten an

initial advantage through the expenditures of the Manhattan Project and being in a much better economic and political position than most countries in the immediate postwar period. Throughout the 1950s, some policymakers began to suspect that the US lead was not as large as it had been, and many nations were beginning to question whether the restraints that came with US assistance outweighed the benefits.[4]

One particular technology, the gas centrifuge, would challenge the US monopoly and come to embody the rising fear that the "nuclear club" could grow much larger. The gas centrifuge is a means of enriching uranium, separating the fissile U-235 isotope from the more common U-238 isotope by circulating gaseous uranium hexafluoride through a cascade of tubes spun at extremely high velocities.[5]

Along with other methods of uranium enrichment, the gas centrifuge was investigated during the Manhattan Project. The physicist Jesse W. Beams, at the University of Virginia, had been working on centrifuges since the mid-1930s and was tapped to head the original centrifuge effort. Initially, the centrifuge work was allocated a much larger budget than was gaseous diffusion and considered much more promising. But the centrifuge work advanced more slowly than was expected, and Beams' initial designs had disqualifying engineering flaws. It was eventually defunded in favor of other methods, despite some Project scientists believing the centrifuge still had promise. But just because Beams couldn't make it work didn't mean it was unworkable.[6]

The Soviet Union had also considered gas centrifuges as a possible method of enrichment from the beginning of their own atomic project. After the defeat of Germany, the Soviets were able to recruit a number of former Axis scientists to work on the Soviet nuclear program. Among these was the German Max Steenbeck and the Austrian Gernot Zippe, who were assigned the task of investigating gas centrifuge enrichment by the Soviets around 1947. They drew upon Beams' pre-war publications and their own research to debug the centrifuge's engineering problems. The Steenbeck group and other Soviet researchers eventually developed a gas centrifuge that, while not yet competitive with gaseous diffusion in terms of efficiency or capability, had a clear path forward for further development. Furthermore, it was conceptually and practically very simple. Unlike the tall centrifuges that Beams was focused on, whose height increased their separative power but intro-

duced severe engineering hurdles, the Steenbeck group's was short and efficient.[7]

Like the Americans, the Soviets primarily used gaseous diffusion enrichment for their early nuclear program, but they would eventually augment their nuclear program with centrifugal enrichment. This by itself would not disturb the Americans much; the Soviets already had a great supply of enriched uranium through the diffusion method. But Soviet centrifuge design did not stay inside the USSR because the researchers who created it did not. Remarkably, Steenbeck had in 1949 negotiated with Lavrenty Beria himself that if he and his team could produce a workable centrifuge pilot factory, they would be allowed in due time to leave the USSR. Even more remarkably, the deal was honored; in late 1953, having produced their success and having convinced the Soviets that the Germans were no longer necessary for the project, the Steenbeck group was put into a "quarantine" of nonmilitary research so that any knowledge they might give the US would be significantly out of date. They were allowed to emigrate in late July 1956 and even paid tens of thousands of rubles for their trouble.[8] Upon leaving, Steenbeck became a professor in East Germany, but Zippe and another colleague, Rudolf Scheffel, went into the capitalist West.[9]

Zippe's name would become synonymous with centrifuge entrepreneurship. After his release by the Soviets, US intelligence agents found and interviewed him for what knowledge he had about the Soviet nuclear program. His description of his centrifuge expertise piqued their interest, and using a false passport, he was allowed to visit the United States for a longer debriefing.[10] By his own account, Zippe had not given much thought to monetizing his knowledge until he attended an unclassified conference on isotope separation held in Amsterdam in April 1957, at which point he realized that the Steenbeck group had produced work that "far exceeded" what was being done in the West. Zippe not only obtained the permission of his former Soviet colleagues, but he drew up a contract with the West German firm Degussa that would clarify patent rights for himself, Steenbeck, and Scheffel.[11] At the conference, he spent two hours talking to the chief Dutch centrifuge researcher, Jaap Kistemaker, and on the basis of this conversation alone, Kistemaker stopped work on the Beams-style long centrifuges and shifted instead toward Zippe-style short centrifuges.[12]

In the summer of 1958, Zippe was persuaded to join the program at University of Virginia and demonstrate what his team had built for the Soviets. This work, remarkably, was done under an unclassified contract. The unclassified nature of this work stemmed from contractual arrangements made between the AEC and Degussa, and the fact that the US did not have an agreement in place to exchange classified information with West Germany. Had Zippe truly been a "free agent," things might have been different, but due to his affiliation with a major West German manufacturing firm, if the US wanted to see what Zippe knew, they had to agree to the whole world potentially seeing it. Zippe produced several unclassified reports on his work for the AEC, including a 98-page final report filed in July 1960. Fifty-two copies of the report were distributed to US researchers, but anyone who requested one could get one. Not long after, Zippe returned to West Germany.[13]

The US had already restarted its centrifuge research at the University of Virginia around 1953, in response to new publications coming out of West Germany and the Netherlands.[14] The West German and Dutch work did not, by itself, highly concern the AEC. The US viewed these early incarnations of the gas centrifuge as less economical and efficient than gaseous diffusion, and the US had enough enriched uranium to supply not only its own military needs but the foreseeable needs of the free world as well. The AEC's own research program, under Beams, was competing better with gaseous diffusion than the European designs. It was making some progress by the late 1950s, largely because the engineering problems encountered by Beams' long centrifuges were being solved through new breakthroughs in materials that had occurred as part of the US space and missile programs.[15]

But there was another framework through which to look at the gas centrifuge. The US was accustomed to thinking about the development of nuclear weapons in the framework it had developed in the 1940s and early 1950s, which focused on large industrial states with many resources valuing efficiency and bulk above all else. But what if future countries did not follow this template? What if they went in a direction that the US had not anticipated, and thus could not control? What if instead of a massive, detectable, difficult-to-produce, efficient gaseous diffusion plant, future nuclear countries chose the technologically less-advanced, but easier-to-produce Zippe-type centrifuges?

The question of "who's next" to get nuclear weapons (as the satirist Tom Lehrer would famously put it) had gradually arisen since the British built their own atomic bomb in 1952. By 1957 this was called, within the realm of intelligence and diplomacy, the question of the "fourth country." But it was gradually becoming clear how unlikely it was that there would be only four nuclear nations; within technical circles, it became fashionable to refer to the spread of nuclear weapons as the "Nth country" or "Nth power" problem (a change made necessary once France detonated its first bomb in 1960). Only by the late 1960s would the present-day term for the spread of nuclear arms to new countries, nuclear proliferation, become standard.[16]

American interest in the centrifuge's proliferation potential was first piqued by the British. John McCone, a businessman who briefly served as AEC chairman starting in 1958 before leaving to become head of the CIA in 1961, met with Sir William Penney, "father" of the British atomic bomb program and veteran of the Manhattan Project, in London in late 1959 to discuss centrifuges. The British were interested in them as a potential source of low-enriched uranium to use for European nuclear power reactors, but Penney was also the one who convinced McCone that they posed a proliferation threat. Penney feared that the West Germans might decide to make bombs, which might threaten the postwar European alliance and revitalize fears of a revanchist foe from a world war still in living memory. Upon his return to the US, McCone commissioned a series of studies on the risks of the gas centrifuge.[17]

One of the first was completed by analysts at the Union Carbide Nuclear Company in February 1960, which divided nations into three categories (low, medium, high) of industrial development and technological competence. The conclusions were grim: the gas centrifuge might not, in 1960, be competitive with gaseous diffusion, but a working plant could probably be made by a less technically proficient nation. A gas centrifuge plant capable of enriching enough uranium for a small number of bombs could be built relatively cheaply, take up a modest amount of floor space (and thus be hidden in any warehouse-sized building), and have power requirements modest enough not to stand out. The authors reasoned that a high-competency country could develop such a facility without any outside help and perhaps have a weapon within 5 years. A low-competency country would need outside assistance, but

with that, even it could manage a weapon within 8 years, albeit at a high price.[18]

Moreover, the gas centrifuge drew attention to a serious problem facing the Cold War secrecy regime. Gas centrifuges were inherently "dual-use": the exact same technology, operated in exactly the same fashion, could produce enriched uranium for a military weapon or for civilian power reactors. Whereas other "peaceful" nuclear technology promoted by the United States, like civilian power reactors, could technically be considered dual-use, they had to be operated somewhat differently for military applications, and such activity either could be easily monitored or might produce plutonium that was less reliable for military purposes. But a centrifuge plant that enriches uranium for nuclear power programs on an industrial scale needs only to be run longer for weapon purposes.

All of which is to say, a nation could develop a civilian centrifuge program and immediately switch it into a military program; indeed, there might not be any real distinction between the two. The result, the AEC concluded, was that a gas centrifuge project would be an ideal choice for an Nth power to run either "covertly" (e.g., as a totally secret project) or "overtly" (as a dual-use project). And there was already some evidence that one of the suspected Nth powers, Brazil, was interested in this route: they had purchased three centrifuge prototypes from West Germany and had sent several of their own people to train with the Germans in their operation, all ostensibly under the rubric of open, peaceful science. Separately, Japan had a research project on long centrifuges of its own that was known to the AEC.[19]

An AEC guide on centrifuge classification developed in the late 1950s had determined that only the long centrifuge work of Beams—i.e., the work they thought might be economically competitive with gaseous diffusion—would be classified. The seemingly less promising short centrifuges were kept completely open. In general, the AEC policy through early 1960 was that centrifuge work was considered unclassified. An internal memorandum makes it clear that this was in part a diplomatic issue: the AEC was monitoring West German and Dutch work on centrifuges and until a "breakthrough" occurred they did not want to muddy the waters with their allies, who were conducting their work without any security classification at all. But by 1960, the AEC

judged that the "breakthrough" had happened, and it was time to clamp down.[20]

Several people, notably McCone himself, expressed doubts that secrecy could be used to rein in this emerging threat.[21] After all, the Zippe "breakthrough" did not originate from AEC research. While the AEC could exercise monopolistic control over its own productions and scientists, and even demand compliance from US industry, could it do the same with West Germany or the Dutch? And would it want to? After all, these were allies, and the US had a vested interest in making sure that these countries remained happily within the fold of NATO. Pushing them too far could lead them to sever their ties and perhaps pursue a more independent path as France had done, developing their own nuclear force. As one US diplomat opined confidentially to another, "I'm afraid some of our AEC friends do not realize that the way German industry has a free hand they could just as easily tell both the German Govt and us to go to hell."[22]

Though US officials considered other options, such as price manipulation of reactor fuel to undercut West Germany and the Netherlands, they ultimately chose to try to extend classification powers into the industries of other sovereign states. The AEC knew this would be difficult and possibly dangerous territory. The sheer number of actors was daunting: they were dealing with not merely foreign governments, but foreign industry and scientists, neither of which were used to working under government secrecy. Though the scientists appeared to have truly intended that their technology be used only to generate low-enriched fuel for nuclear power reactors, the AEC worried that their national leaders might eventually develop other ambitions, and that in any case, the open publication and circulation of this work would certainly benefit other Nth powers in waiting. The AEC understood that there were severe political issues. The treaty that had created the Euratom organization required a certain amount of sharing between Euratom members; if West Germany and the Netherlands suddenly put its civilian work under military classification, it could raise the ire and suspicion of their fellow Euratom members, if not constitute a treaty violation.[23]

Through diplomatic channels, the US provided the West Germans and Dutch with a 2-page guide to classification practices, effectively exporting the AEC system in July 1960. Both countries accepted, albeit

with some reservations. Both nations treated this agreement as a matter of domestic policy, not international obligation, and reserved the right to modify or abandon the arrangement unilaterally. The AEC perceived this to be a means of retaining autonomy and avoiding some of the political difficulties that might come from seeming unduly beholden to the US, while also giving them some leverage to keep the US from pushing them too hard.[24]

The AEC briefed the Joint Committee on Atomic Energy on the arrangement at a closed session in October 1960. It was a "sobering" presentation for the congressmen. The list of countries the AEC feared getting nuclear weapons was not a comforting one: Cuba, Japan, Israel, Egypt, Argentina. But questions were once again being raised about secrecy as a blanket solution. Demonstrating the JCAE's shifting views on secrecy, its chairman, Senator Clinton P. Anderson, criticized an AEC witness for labeling his charts "Secret," even though they were just lists of US companies doing unclassified research into centrifuges.[25] Later, as the AEC representatives explained that publications on centrifuges were coming out of not only Western European countries, but also East Germany and Poland, Anderson again questioned whether secrecy would matter at all. The Brazilians, after all, had already bought West German centrifuges, legally and uncontrolled. "You don't just make an automobile and try to sell [it] to people and then say, 'this is a secret device,'" Anderson lampooned. He was doubtful the Germans would want to participate at all: "How do you take it out of the market? What are you going to pay them for staying out of the market? What is your proposal in order to get them to classify? Are you offering to pay them so much money so they won't use it?"

The representatives from the AEC, as well as a representative from the State Department, took pains to emphasize that the Germans and Dutch had already agreed to keep future work under classification. McCone still expressed grave doubts: "As to any clear pattern of how we are going to control [centrifuges], we haven't reached that point yet. It may have gone entirely past the point of no return. Maybe we can't do anything about it at all." AEC assurances of cooperation may have mollified the congressmen a bit, but the overall tone of the meeting was one of suspicion and dread. One congressman noted toward the end of the session that "the possibilities are horrifying."[26]

The revisions to the Atomic Energy Act in 1954 had been made in part to open the field of nuclear technology to private industry within the US, while attempting to keep certain controls over the flow of classified nuclear information in place. These two goals were recognized as being difficult, though not impossible, to reconcile. Some of this was accomplished through declassification efforts, but the 1954 Revision also explicitly allowed industrial access to Restricted Data for civilian purposes through AEC licensing. A 1955 program allowed vetted industrial companies to have access to Restricted Data in exchange for the company giving the AEC full access to any technical data or experimental equipment generated, and allowing the AEC to license any deriving technologies for what the AEC considered reasonable compensation.[27] It was, to put it mildly, a somewhat one-sided deal.

But Restricted Data was a tricky concept that was getting even trickier over time. The original conception of Restricted Data, starting with the Atomic Energy Act of 1946 but continued in the 1954 Revision, was that the information was secret by definition. Classifiers didn't tell you that they had determined whether a document was Restricted Data, they told you whether it contained it. This is a subtle distinction, but an important one when it came to the private sector. Could a company that was researching centrifuges without any access to government-produced Restricted Data still generate Restricted Data? A strictly legal reading of the law implied that the answer was *yes*: Restricted Data was not Restricted Data because of its association with the AEC, it was Restricted Data because it was about nuclear weapons. This matter seems not to have been anticipated by the drafters of either the 1946 Act or its 1954 Revision, again, likely because prior to the late 1950s, there were no competitors to the AEC as a generator of Restricted Data.[28]

The gas centrifuge caused the AEC to revisit this policy. In August 1960, it decided that all further work on the gas centrifuge in the United States, even that produced by private industry, would be regarded as Restricted Data. The policy was a stark one: while that which was already unclassified did not change its status, any elaborations were suddenly controlled. This came as a surprise to the few US companies working in the field who suddenly saw the limits of secrecy

closing in around them.[29] Could the AEC tell a US company that had put its own funding into gas centrifuge research based on unclassified publications that it was not allowed to pursue the work without first obtaining a security clearance? The official AEC position was now *yes*, so companies that wanted to work on centrifuges now had to join an AEC permit program even if they had no intention of receiving any Restricted Data.[30]

Over the course of the 1960s, these issues got more complicated. In 1967, the AEC proposed that companies would need to get "private restricted data access authorization" to work in areas such as centrifuges that might impinge on weapons design or isotopic enrichment. This was criticized as vague, burdensome, and bureaucratic.[31] More specific regulations designed to clarify the proposal were labeled by one former AEC lawyer as having "produced an ambiguous, hair-splitting, administrative monstrosity" and were likewise abandoned.[32] By 1969, there had been no official policy clarification; indeed, there would not be one before the AEC was abolished in 1975.[33]

Ultimately, US industrial companies who wanted to research centrifuges were allowed to, so long as they got the required permits. This forced several companies out of the field, but a handful stayed in the game. By 1967, only 140 technical employees were working in the US private sector on centrifuges. From a security standpoint, this was a good thing; as an AEC report noted, "[I]n a general sense, the possibility of inadvertent disclosure in any control system is in part a function of the number of people—and particular the number of organizations—who have access to the information being controlled."[34] The AEC record on voluntary domestic compliance with its demands regarding Restricted Data, through the end of the 1960s, was essentially perfect: legal intervention was never required, and the "born classified" interpretation of the Atomic Energy Act was not put to a real test.[35]

Internationally, things were trickier. Ideally, the AEC might have hoped to open up a more formal collaboration with the West Germans and the Dutch, as they had on nuclear matters with the United Kingdom. The US and the UK began collaborating on classified centrifuge technology from the end of 1960 through early 1965, an arrangement that not only afforded the US considerable latitude in monitoring British progress, but also made it difficult for the British to serve as

competitors: because the British scientists had been exposed to AEC-generated Restricted Data, they were essentially prohibited from commercializing their work in any way that might expose Restricted Data. Lamenting how much this complicated efforts to develop civilian technology, the UK Minister of Technology wrote in his diary that the UK was "absolutely tied hand and foot to them, and we can't pass any of our nuclear technology over to anybody else without their permission."[36]

The Dutch had scaled back their project to a mere six scientists and ten engineers, but they still made considerable progress.[37] The Dutch scientists were particularly unhappy that classification would inhibit their collaboration with others (they were exploring partnering with the West Germans and perhaps even a US firm) and wondered how a nation that did not have significant scientific secrecy was expected to impose it. How would scientists be screened? Under what criteria? These were hard questions for a scientific community that had largely avoided secrecy regimes.[38] Both the West Germans and Dutch would complain to the US that they wanted the ability to file secret, potentially lucrative centrifuge patents in other NATO countries, a request that the US, in meeting with the UK, Dutch, and West Germans in 1962 and 1964, pointed out created a whole host of problems with regard to secrecy, international treaties (e.g., Euratom), and practicality.[39]

By 1964, the Dutch felt confident enough in their research that they were planning to develop a pilot plant. They requested another meeting of the US, UK, Dutch, and West Germans with the aim of reexamining secrecy arrangements. At the meeting, the Germans and Dutch reaffirmed their commitment, but the AEC representatives noted that they were "reluctant partners to the classification arrangements." They further reported that in West Germany, the Ministry of Scientific Affairs had recommended that the classification of gas centrifuges be ended, and that it was preserved only through political intervention by the Ministry of Foreign Affairs. The Dutch had suggested that classification should be regularly revisited, and secrecy would have to become less rigid as information barriers eroded over time. The AEC representative urged to the rest of the commission that while the policy was being maintained for the present, the internal pressures building against classification within West Germany and the Netherlands were "substantial."[40]

Within the US, new breakthroughs in long centrifuges led, in 1965, to a termination of cooperation with the British. The UK pushed ahead on their own centrifuge research, both for its technological possibilities and also to "wean" West Germany off close collaboration with the French.[41] At the same time, the US began to worry more about the proliferation risks posed by the centrifuge, with AEC Commissioner James Ramey ordering a major study on the subject. The study, not completed until early 1967, reaffirmed that the gas centrifuge could be a game-changer, highlighting that centrifuge work allowed a nation to work toward a bomb with "relatively low capital investment, low electrical power requirements, and easy concealment." The AEC study also concluded that there was now enough information in the open literature for a country "willing to pay a high price for a few weapons" to begin an effective centrifuge program from scratch. The list of countries that the AEC believed could get a weapon within a decade was a long one: Belgium, Denmark, Italy, the Netherlands, Norway, Portugal, Spain, Argentina, Brazil, Czechoslovakia, and East Germany. Furthermore, neither the AEC nor the IAEA had ever attempted to apply international safeguards to any isotope separation facility. Complicating things further was that with a booming nuclear power market, the US was no longer confident it could continue to meet demands for low-enriched uranium in the future. Nevertheless, the AEC was still stuck in its secrecy regime: "[T]here appears to be little choice but to continue the policy of classifying and controlling gas centrifuge technology," the report's authors concluded.[42]

By 1968, the situation had worsened. The West Germans, Dutch, and UK had thrown their lot in together to create a new centrifuge plant operated for profit by an international consortium, known as Urenco. The US had resisted internal pressures to advocate for the prohibition of centrifuge technology as part of the Nuclear Non-Proliferation Treaty because it feared that doing so would give the West Germans an excuse not to sign what was in their country an unpopular agreement.[43] After some initial hiccups created by the "contamination" of UK centrifuge work by AEC Restricted Data during the US-UK period of collaboration, the effort moved forward, with major enrichment plants being built in Capenhurst, UK, and Almelo, the Netherlands.[44] It had taken a little over a decade, but for better or worse, the centrifuge work that

had begun in the Soviet Union had finally taken root in the European free market.

The Cold War secrecy regime demanded firm boundaries between what was secret and what was not, between who had access to that information and who did not. But these boundaries began to become "tricky," not only because the number of players, both domestically and internationally, began to expand, but because some of these boundaries were themselves epistemically fraught. Restricted Data was a concept that, in its "born secret" implementation, crossed boundaries by definition: it did not care who made the data or for what purposes. And the categories of "private," "AEC," and even "American" could be very complicated in practice: Zippe, for example, was an Austrian physicist who had worked in the USSR and then emigrated, who had come to the US to do unclassified research for the AEC on a subject that would later be regarded as Restricted Data, after he had told the Dutch about it and had entered into a contract to develop it for West German industry. Real people were more complicated than neat Cold War idealized categories.

And yet, while the fears of nuclear proliferation, particularly the role of the gas centrifuge, grew over the course of the 1960s, there is little to suggest that the AEC fully understood the difficulties they were creating. Even today, there are questions about how much the centrifuge has changed the nature of proliferation.[45] On the whole, the risk of "Nth powers" acquiring centrifuge technology appeared looming but not imminent. The AEC had gotten what it demanded from both private industry and foreign partners. But the proliferation problems that would become evident in the longer arc of the centrifuge's history would demonstrate the AEC's weaknesses as its own Cold War regime demanded rigid and clear boundaries in an increasingly interconnected and complicated world.

7.2 THE PERILS OF "PEACEFUL" FUSION

Nuclear fusion has proven much less amenable to being used for peaceful applications than nuclear fission. Despite its promise of virtually