Natural Resources Defense Council, Inc.

1725 I STREET, N.W.
SUITE 600
WASHINGTON, D.C. 20006

202 223-8210

New York Office
122 EAST 42ND STREET
NEW YORK, N.Y. 10168
212 949-0049

Western Office
25 KEARNY STREET
SAN FRANCISCO, CALIF. 94108
415 421-6561

Testimony of

Thomas B. Cochran and Jeffrey I. Sands

on behalf of the

Natural Resources Defense Council

before the

Subcommittee on Energy Conservation and Power

of the

Committee on Energy and Commerce

of the

U.S. House of Representatives

October 21, 1983

New England Office: 16 PRESCOTT STREET • WELLESLEY HILLS, MA. 02181 • 617 237-0472
Public Lands Institute: 1720 RACE STREET • DENVER, CO. 80206 • 303 377-9740

Summary of Testimony of Thomas B. Ccohran and Jeffrey I. Sands of the Natural Resources Defense Council before the Subcommittee on Energy Conservation and Power of the Committee on Energy and Commerce of the U.S. House of Representatives

This testimony addresses two questions: first, the nuclear weapons proliferation risks associated with development of AIS processes, and, second, the advisibility of proceeding with Phase II of the Set III GCEP machine procurement contracts to be let this fiscal year.

Nuclear Weapons Proliferation Implications

We endorse the finding regarding proliferation considerations of AIS technologies of the ERAB Study Group's 1980 Report on Advanced Isotope Separation, and the report's conclusion that proliferation risks should be treated as a central design problem for the processes.

The greatest proliferation risk associated with federal AIS development is DOE's plan to employ Pu-LIS to enrich 10-15 tons of fuel-grade plutonium in the existing DOE stockpile, including plutonium derived from or currently used in civil R&D reactors, for its use in the weapons program. This DOE plan is not prohibited by law due to a loophole in the Hart-Simpson-Mitchell Amendment to the Atomic Energy Act (Section 57, ¶E). It violates, however, the spirit of the NPT presumption against the use of civilian nuclear technology for military purposes and undermines the bedrock foundation of U.S. non-proliferation policies that a clear distinction can be made between civilian and military applications of nuclear technology. Pu-LIS cannot be justified on the basis of either economics or national security, and we urge the committee to support efforts to close this loophole. DOE has also failed to prepare a programmatic Environmental Impact Statement (EIS) for Pu-LIS as required by NEPA, and we urge this committee to demand that DOE comply with the NEPA requirement.

DOE's work on the Plasma Separation Process (PSP), also being funded under DOE's Defense Programs budget, has significant nuclear weapons proliferation implications. PSP could significantly increase the proliferation hazard of worldwide uranium enrichment activities due to its modular design, established technology and hardware, and smaller size. The technology has not been demonstrated. Due to PSP's proliferation potential, it is questionable whether this program should be continued.

Phase II Set III Machine Procurement

The U.S. has a huge excess in uranium enrichment capacity with the three existing gaseous diffusion plants, and the current market situation does not compel us to add new Set III capacity in order to meet demand until the early 1990s when AGC and AVLIS technologies will be fully developed. Since a decision between construction of AGC or AVLIS capacity cannot be made at this time, a decision to build process buildings beyond the first two at GCEP, already committed, should be deferred until the 1986-1987 AGC vs. AVLIS competition is complete.

We see no economic advantage in Phase II Set III machine procurement and deployment over continued operation of GDP capacity. In fact, there very well could be a significant economic penalty associated with continuing Phase II Set III procurement activities. We therefore urge this committee to ask DOE to cancel or minimize the procurement of Set III machines via Phase II contracts to the lowest possible level consistent with retaining a capability to deploy AGC (Set V) in a timely manner.

Mr. Chairman and Members of the Committee:

We are pleased to appear before you on behalf of the Natural Resources Defense Council (NRDC) to discuss issues involved with uranium enrichment development strategies. NRDC is a public interest environmental protection organization with some 45,000 members in the United States and abroad and extensive technical and policy expertise on nuclear matters. Dr. Thomas B. Cochran is a Senior Staff Scientist at NRDC. He was a member of the Department of Energy's (DOE) Energy Research Advisory Board (ERAB) from 1978 to 1982. He was also a member of ERAB's Advanced Isotope Separation (AIS) Study Group in 1980 and 1982 which reviewed and reported on the Department's civil AIS program. Jeffrey I. Sands is a research associate with the NRDC Nuclear Nonproliferation Project. He worked at the Center for Strategic and International Studies of Georgetown University from 1982 to 1983, where he wrote a draft paper on U.S. uranium development strategies.

This testimony addresses two main questions: first, are there significant nuclear weapons proliferation risks associated with development of AIS processes, and, if so, how do these risks compare with alternatives currently available -- gaseous diffusion and gas centrifuge plants. Second, in light of the major crisis in which the U.S. uranium enrichment enterprise finds itself, does it make sense to proceed with Phase II of the Set III Gas Centrifuge Enrichment Plant (GCEP) machine procurement contracts to be let this fiscal year? We will address these issues independently.

Nuclear Weapons Proliferation Implications

The Energy Research Advisory Board (ERAB) Study Group on Advanced Isotope Separation (AIS), of which Dr. Cochran was a member, examined the nuclear weapons proliferation implications in its November 1980 report. The findings of this ERAB report are attached as an appendix to this testimony. In sum, we agree with the Study Group's overall conclusion that AIS technology development itself does not pose a more significant proliferation risk than gaseous diffusion or gas centrifuge technologies, though this may change in the future. As it now stands, the AIS process would not be the best choice for a would-be proliferant. With regard to Advanced Gas Centrifuge (AGC) development, that technology would not have more of a proliferation risk than the currently available gas centrifuge or gaseous diffusion technologies.

At least one item of the ERAB report should be highlighted:

> While steps could be taken in all AIS processes to provide significant deterrence to diversion of material or separative work, no evidence was presented to indicate that the program is giving serious attention to these matters at this time.

We would emphasize that the nuclear weapons proliferation considerations of AIS, including the civil Atomic Vapor Laser Isotope Separation (AVLIS) process under development, must be given serious attention. However, at least as late as the 1982

ERAB review, DOE was not considering the proliferation issue adequately in decisions related to the choice of AIS technologies or their development.

When the ERAB Study Group's report was written, the bulk of AIS R&D efforts addressed civil nuclear energy problems. Classified work on AIS technologies for plutonium separation was at the time being piggybacked on civilian R&D. Since that time the funding priorities have been reversed; the bulk of AIS work is now being funded under DOE's Defense Programs for nuclear weapons-related applications, and the civilian AVLIS work is being piggybacked on this weapons program effort.

Two aspects of this weapons-related work have serious nuclear weapons proliferation implications. Because of the close linkage between the civil and weapons AIS programs, we believe it is approriate for this committee to examine these issues.

First, it is our belief that the greatest proliferation risk associated with the federal AIS development program is the fact that DOE is planning to employ the AVLIS technology to enrich approximately 10-15 metric tons of "fuel-grade" plutonium to "weapon-grade" for use in nuclear weapons. About half of this plutonium is derived from, or currently used in, DOE's civil R&D reactors.

Proceeding with this plan violates the spirit of the Nuclear Non-Proliferation Treaty (NPT) presumption against the use of peaceful nuclear technology for military purposes and would commit the very act that U.S. non-proliferation policies have tried to prevent for three decades. It would undermine the assumption of U.S. nuclear cooperation policies that a clear distinction exists between civilian and military applications of nuclear technology.

Currently, there is no prohibition against the use of civilian R&D plutonium for weapons purposes. The Hart-Simpson-Mitchell Amendment to the Atomic Energy Act (Section 57, ¶E) prohibits the use of plutonium derived from licensed power reactors for weapons purposes, but it is silent with regard to plutonium derived from, or currently used in, unlicensed research reactors that are dedicated for peaceful applications. We don't believe that the U.S. Pu-LIS development effort can be justified on the basis of either economics or national security, since there are existing means -- namely, blending, which does not require large R&D expenditures -- to enrich to weapon-grade the non-civilian fuel-grade plutonium in DOE's inventory. The DOE has failed to prepare a programmatic environmental impact statement (EIS) for the Pu-LIS development program, as required by the National Environmental Policy Act (NEPA). Such an EIS would analyze all the environmental consequences of the program and its costs and benefits. Moreover, if the loophole in the Hart-Simpson-Mitchell Amendment was closed, DOE's principal argument for proceeding with Pu-LIS (which we believe is dubious) -- namely the access it would provide to DOE's civilian plutonium stockpile for weapons purposes -- would be removed. We therefore urge this committee to take steps to demand that DOE comply with

NEPA and to prohibit any use of civilian R&D plutonium in the manufacture ofatomic bombs.

The other aspect of DOE's defense-related AIS work with nuclear weapons proliferations implications is the DOE Defense Programs work on the Plasma Separation Process (PSP), one of the three AIS processes (AVLIS, MLIS, and PSP) under development by DOE for civil uranium enrichment applications prior to the selection of the AVLIS process. The weapons program is currently spending about $12-14 million annually to develop PSP for enriching uranium by removing U-236 from uranium recovered from naval reactor and production reactor spent fuel. Removal of the U-236 would improve the characteristics of the recycled uranium for use as a fuel in defense-related production reactors.

We call your attention to the statement made in the ERAB Study Group 1980 report which noted that

> the technologies and hardware requirement of the PSP are more established than those used in laser processes, and the smaller size of an economical PSP module may make PSP more of a proliferation hazard.

If PSP development is successful, it could very well turn out to represent a much greater proliferation hazard than GDP and GCEP-AGC enrichment capacity. Its modular design and use of more established technology may make it the most attractive technology to a potential proliferant. As with the Pu-LIS, we are not aware of any economic or environmental impact analysis for this technology. We feel that Congress should defer funding development of PSP until DOE can demonstrate that the economic merits of this program outweigh its proliferation risk.

In conclusion, we urge that this committee pay careful attention to the proliferation implications of advanced uranium enrichment technologies, in particular to those associated with Pu-LIS and PSP technologies. Only through diligence on the part of Congress will the proliferation risks be minimized.

Set III Gas Centrifuge Procurement

Introduction

DOE's uranium enrichment enterprise is now in turmoil. Worldwide slowdowns in reactor construction and resultant reductions in free world nuclear power growth projections and the emergence of foreign suppliers -- e.g., Eurodif and Urenco, European-based consortiums, and the Soviet Union -- have created a "buyer's market" in which the U.S. share has fallen dramatically. Such foreign suppliers have strong commitments to ensure the viability of their enterprises, and can therefore be expected to pressure their respective utilities (or decide for them as the case may be) to switch supply contracts away from DOE. Moreover, the vast worldwide oversupply in enrichment capacity has created a strong secondary enrichment market by which foreign suppliers have been making inroads into the domestic U.S. market, a market in which DOE has until recently enjoyed a monopoly. Clearly, if the U.S. is to retain a significant share of the free world's enrichment market, something must be done to enhance the competitiveness of U.S. enrichment services.

DOE's response to this situation has been to stick by the decision it made when projected demand for enrichment services was still rising, namely, to sink billions of dollars into the construction of a new enrichment facility using the gas centrifuge technology. DOE expects this facility, known as the Gas Centrifuge Enrichment Plant (GCEP), to provide enrichment services at a significantly lower cost than equivalent services from the three existing U.S. gaseous diffusion plants (GDPs). DOE is also accelerating R&D on two advanced enrichment technologies, advanced gas centrifuge (AGC) and Atomic Vapor Laser Isotope Separation (AVLIS), both of which promise to produce enrichment services, quantified in separative work units (SWUs), at a lower cost than can be currently obtained from GDP or GCEP with the Set III centrifuge machines presently available.

A key question facing the Congress is whether to proceed with Phase II of the Set III machine procurement contract, which is to be let during this fiscal year. It is important to evaluate this investment strategy compared to alternative strategies to determine whether Set III machines will produce SWUs at the lowest cost. It is also important to understand the extent to which purchase of additional Set III machines will prejudice a future economic comparison -- or shootout, if you will -- between the AGC and AVLIS technologies.

Background

We make the following observations:

1. The U.S. currently has a huge excess in uranium enrichment capacity with the three existing gaseous diffusion plants. These three plants have a total annual capacity of 27.3 million SWU, a level of capacity that will be adequate to meet even optimistic projections of demand for U.S. services at least up to the late 1990s as projected by DOE. We believe current capacity will be adequate beyond the year 2000 due to the opportunities for stockpiling by over-producing in earlier years, the likelihood of additional shrinkage of the U.S. share of the market as a result of curtailments in nuclear power programs and aggressive competition, the unlikelihood of increased government demand, and the opportunities for reducing production requirements to meet projected demand by increasing the operating tails assay. In any case, since enrichment capacity construction lead-times are shorter than those for new nuclear power generating capacity, additional enrichment capacity can be built if and when it is needed to meet new generating capacity growth plans. Thus, deployment of new gas centrifuge capacity is not needed now to meet projected increases in demand.

2. Proceeding simultaneously with two large advanced technology development efforts, AGC and AVLIS, cannot be justified on economic grounds. Were the U.S. enrichment enterprise operated as a private venture, it is unlikely that both of these technologies would be pursued at current levels.

Consequently, DOE should be looking for ways to make an early selection of the most cost-effective of the two technologies.

3. Deployment of advanced enrichment technologies only make sense if and when these technologies can be shown to produce SWUs at a lower cost than can be currently obtained from GDP. While both Set V AGC and AVLIS offer a high potential for long-term reduction in SWU cost, this does not imply that Set III deployment is cost-effective in the short term.

4. Current DOE program plans contemplate a detailed evaluation of AGC and AVLIS in the 1986-1987 period in order to select one of the processes for further development. In the interim, one should minimize the cost of GCEP construction until the economic "shootout" between AGC and AIS technology by not proceeding beyond the completion of the first two process buildings (2.2 million SWU with Set III machines). This observation was also made by the ERAB Study Group Report of 1980. DOE reportedly also concurs with this recommendation, deferring GCEP construction beyond two process buildings, until a decision in the late 1980s on whether to use the AGC or AVLIS process to displace existing GDP capacity.

<u>Economic Analysis of Phase II Set III Gas Centrifuge Machines</u>

At this time, contracts have been let for purchase of Set III machines for 3/8 of process building 1, a total of 2160 machines (3 trains of 720 machines each; each train is made up of 6 cascades with 120 machines in each), to be installed beginning next month. When fully installed, these machines will have an annual capacity of just over 0.4 million SWU. DOE reportedly wants to let contracts for an additional 6480 Set III machines (nine trains, enough to fill 1-1/8 of process buildings 1 and 2) early next year. These additional Set III machines could produce 1.2375 million SWU annually, providing for a total annual GCEP SWU production capability with a full complement of Set III machines in process building 1 and 1/2 of process building 2 of 1.65 million SWU.

The two alternative strategies used in our economic analysis are outlined below. Both strategies assume that Set III machines producing 0.4125 million SWU annually are fully installed and operating by FY 1988. They also assume that Set V AGC machines will be available for installation or retrofit beginning in January 1989.

Case 1 -- This case, recommended by DOE, calls for completion of process buildings Nos. 1 and 2, and purchase of the additional Set III machines for a total GCEP annual capacity using Set III machines of 0.4125 million SWU in FY 1988, 1.1 million SWU in FY 1989, and 1.65 million SWU in FY 1990-1992. DOE's operating plan for Case 1 is presented in Table 1:

Table 1

Case 1 DOE Operating Plan Assuming Current UEA Mid-Level Demand Projections,* Set III Procurement and Installation in P.B. No. 1 and Half of P.B. No. 2

Production Level*
(millions of SWU)

	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992
GDP	18.5	18.4	18.4	18.4	17.1
GCEP (3/8 P.B. No.1 committed)	.4125	.4125	.4125	.4125	(Set V retrofit)
GCEP (Phase II Set III contracts)	-	.6875	1.2375	1.2375	1.2375
GCEP Set V		remainder	remainder	remainder	remainder

* These production levels are based on DOE's most recent Uranium Enrichment Operating Plan. The demand projections used in this plan have since fallen 0.7 million SWU in FY 1988 and 0.8 million SWU in FY 1989-1992. In the above plan, GDP production has been reduced by these amounts since GDP capacity is significantly more power-intensive than GCEP Set III capacity. It is recognized that other production factors could be altered instead, e.g., feed inventory, stockpile levels, and tails assay. These factors are assumed to be the same for purposes of simplification.

Case 2 -- This case calls for completion of process buildings 1 and 2, but no additional purchase of Set III machines beyond providing for .4125 million SWU annual capacity already committed. GDP production levels are increased by the amount that would have been produced by the cancelled Set III machines from the Phase II procurement contract. Case 2 is presented in Table 2:

Table 2

Case 2 Operating Plan Assuming Cancellation of Phase II Set III Machine Procurement Contracts and Increased GDP Production

	Production Level (millions of SWU)				
	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992
GDP	18.5	19.0875	19.6375	19.6375	18.3375
GCEP (3/8 P.B. No.1 committed)	.4125	.4125	.4125	.4125	(Set V retrofit)
GCEP (Phase II Set III contracts)	-	-	-	-	-
GCEP Set V		remainder	remainder	remainder	remainder

In order to compare the two alternatives, we need only to examine the costs of producing the SWUs that would be produced under Phase II Set III contracts for the lifetime of the machines (assumed to be 4 years) and compare this with the costs of producing the equivalent SWUs using GDP during the same time period. Since the costs of the baseline GDP production in Case 1, the operation of the already committed Set III machines (.4125 million annual SWU) and future procurement and operation of Set V are the same in both cases, these costs are not reflected in our analysis below. DOE projects that Set III machines will have a lifetime of three to four years. In our analysis, we perform sensitivity cases in which the average lifetime of Set III machines is 3 or 4 years. To simplify the analysis, we assume that all Set III machines are replaced at the same time, that is, at the end of three or four years. We should add that it is not cost-effective to retrofit Set III with Set V machines before the Set III machines wear out.

Table 3

Cost Comparison of Case 1 and Case 2
(in millions of FY 1984 dollars)

Phase II (9/8 P.B.) Set III Operating Period	CASE 1 (9/8 P.B. Set III GCEP)	CASE 2 (GDP)	CASE 2 Cost Advantage
FY 1989-1991	406.4-529.5	303.6-322.6	83.8-222.9
FY 1989-1992	436.1-559.2	422.4-488.8	(-52.6)-159.6

NOTES: The actual cost for 6480 Set III machines has yet to be determined, and DOE's cost projections have not been released. Our projections assume on average $51,000-70,000 per machine. GCEP operating costs assume $21/SWU, and $3/SWU is used to project GCEP power costs. GDP operating costs assume $11-12/SWU, and GDP power costs are $85-90/SWU.

The results of the economic comparison of these two cases is presented above in Table 3. Within the uncertainties of our ability to project costs, there is no economic advantage of Phase II Set III machine procurement and deployment over continued operation of GDP capacity. Consideration of two additional factors would favor GDP capacity over Phase II Set III machine procurement activities. First, factoring in a discount rate for the cost of money would make GDP production even more favorable relative to GCEP Phase II Set III production since the latter's high capital outlays would occur before the outlays for power to increase GDP production. Second, the cost of Phase II Set III machines is likely to be closer to our high estimate of $77,000 per machine, since that would be the cost associated with purchasing enough machines for only two process buildings. (The low-cost estimate for Phase II Set III machines is that associated with a full eight-building GCEP.)

The analysis above does not take into consideration the risk that some or all of the three centrifuge manufacturers would lose interest in the program if the Phase II Set III contracts were cancelled. Given their R&D investments to date, we believe that it is highly unlikely that all of the manufacturers would bow out. In any case, three manufacturers are not needed. Nevertheless, manufacturers that remain despite the cancellation of potential Set III contracts are likely to raise their prices for the Set V AGC machines, a factor which should be taken into consideration in the overall economic evaluation. A stretched-out production schedule for machines already contracted for and/or a significantly reduced and stretched out Phase II Set III procurement contract, would provide two or three centrifuge manufacturers with a solid machine manufacturing rate per month. (Purchasing an additional 2160 machines, for example, would give three manufacturers an additional 720 machines each over a five-year period, or 12 machines per manufacturer per month. Two manufacturers would have a manufacturing rate of 18 per month.) This would minimize the risk of manufacturer loss of interest and minimize increases in the capital cost of Set V machine procurement.

Conclusions and Policy Recommendations

(1) Given the need for cheaper SWUs rather than more SWUs, the key question is how best to make the transition from gaseous diffusion production to the most cost-effective process. Since an evaluation between AGC or AVLIS processes cannot be made at this time, construction of further enrichment capacity should await a decision of whether to use the AGC or the AVLIS process. Hence, a decision to build process buildings beyond the first two at GCEP should be deferred until the 1986-1987 AGC vs. AVLIS competition is complete.

(2) Assuming Set III machines have a life-cycle up to four years on average and recognizing that it doesn't pay to rip out these machines, there is no economic advantage of Phase II Set III machine procurement and deployment over continued operation of GDP capacity. Rather, there would most likely be a significant economic penalty associated with continuing Phase II Set III procurement activities.

(3) Either cancel or minimize the procurement of Set III machines via Phase II contracts to the lowest possible level which would retain a good capability to deploy advanced gas centrifuges. An adequate centrifuge manufacturing base probably can be maintained by stretching out existing contracts. If not, purchase of a small number of additional Set III machines may be necessary. The number of additional Set III machines necessary is considerably less than the 6480 planned under Phase II Set III contracts.

APPENDIX A

REPORT

OF THE

ENERGY RESEARCH ADVISORY BOARD

STUDY GROUP

ON

ADVANCED ISOTOPE SEPARATION

NOVEMBER 1980

(Section 3.4 Nuclear Weapons Proliferation Implications)

3.4 Nuclear Weapons Proliferation Implications

The nuclear weapons proliferation implications of advanced isotope processes have been reviewed by DOE and others. (References 28-34 inclusive)

In assessing the proliferation risks of AIS processes, three technical paths, ranked in order of importance, must be considered:

- the process will be developed independently by another nation for the production of weapons material;

- the process designed for LEU production will be altered to produce HEU; and

- LEU will be diverted from the plant to subsequent production of HEU.

In each case, the central question is whether the proliferation risks will change (and in what direction) with the development and deployment of these new technologies; therefore, the proliferation risks of each AIS process must be compared against alternatives currently available -- gaseous diffusion and gas centrifuge plants. Likewise, consideration must be given to the fact that AIS technologies are being developed independently in other countries.

All AIS processes involve the successful integration of several sophisticated technologies and, as such, none presents a significant risk in terms of development from the ground up by small non-government organizations (i.e., individuals or terrorist organizations).

All AIS processes are at early stages of development (i.e., research programs) and have produced only gram quantities of LEU, whereas the gas centrifuge technology has been deployed commercially. The early stage of AIS development, together with the inherent high-technology aspects of AIS processes, make them unlikely avenues for proliferation now by any except advanced countries. Thus, the remainder of this discussion assumes the AIS processes have been succesfully developed and deployed as mature industries.

Independent process development by another nation could follow two paths. First, the country could develop the process independently by initiating its own research effort and technological development program; or, alternatively, the country could obtain access to the technology (e.g., engineering plans) and purchase the needed hardware on the commercial market. The first alternative probably more nearly describes the historic development of gaseous diffusion technology by the United Kingdom and France, and perhaps of the aerodynamic process by South Africa. The second alternative is currently being attempted by Pakistan in developing a gas centrifuge plant.

All of the AIS processes appear today to be substantially more difficult to develop from scratch than the gas centrifuge and, consequently they are not now the preferred (proliferation) alternative and do not add significantly to the "baseline" risk. If and when the laser processes become publicly well understood, they may still be less attractive than the gas centrifuge process for dedicated HEU production in small amounts because of their sophisticated technologies. However, the technologies and hardware requirement of the PSP are more established than those used in laser processes, and the smaller size of an economical PSP module may make PSP more of a proliferation hazard.

Whether any of these differences between AIS and gas centrifuge will be significant in the future depends on a number of factors, e.g., developments in laser technology and their deployment. These are difficult to predict and, consequently, these assessments must be subject to continued scrutiny and declassification actions should not be taken lightly. The projected costs for AIS suggest that by the 1990s one or more of these processes may become the favored process for proliferation, particularly if there is access to the technology on an unclassified or otherwise available basis.

All AIS processes designed for LEU production seem capable of modification to HEU production. Since the processes are optimized for LEU, the alterations including, for example, reduced feed flows cause a reduction in plant capacity (i.e., SWU/yr). However, this would not be a significant penalty under some diversion scenarios because a weapons program needs such small amounts of separative work compared to supplying LEU to large power reactors.

All AIS processes and gas centrifuges, however, in theory could be designed (and safeguarded by inspection) -- in some cases without significant penalty to plant performance or economics -- to make covert conversion of an existing AIS facility for LEU to HEU production (while under safeguard inspection) exceedingly difficult. A gas centrifuge facility which was not under safeguards control would be simpler to convert covertly and, thus represents a higher proliferation risk. AIS plants are expected to have very few equipment modules compared to the thousands of centrifuges.

All AIS processes have one advantage over gaseous diffusion (but not gas centrifuge) plants with regard to diversion of LEU for subsequent production of HEU, namely, they have lower in-process inventories, which could lead to better material accounting and control. However, because designs and operating procedures are not yet focused it is difficult to judge the relative merits of the AIS processes with regard to LEU diversion, or to compare them against the existing diffusion or centrifuge concepts.

While steps could be taken in all AIS processes to provide signficant deterrence to diversion of material or separative work, no evidence was presented to indicate that the program is giving serious attention to these matters at this time.