Comments on the Draft Environmental Impact Statement for Construction and Operation of Claiborne Enrichment Center, Homer, Louisiana, NUREG-1484

by

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Introduction and Overview

There are a number of serious flaws in the Draft Environmental Impact Statement (DEIS) for the construction and operation of the proposed Claiborne Enrichment Center (CEC) being considered for Homer, Louisiana. These comments address two sets of difficulties: methodological/logical problems and ethical problems in the analysis. This document argues that the general scientific methodology/logic of the DEIS is seriously flawed in at least six ways. (1) There are no adequate arguments to establish the need for the proposed facility, as required by the US National Environmental Policy Act (NEPA). (2) There is no adequate exploration of alternatives to the facility, as required by NEPA. (3) There is no adequate justification for eliminating potential North Carolina sites, assuming other serious arguments against the facility could be answered. (4) The accident evaluations in the DEIS are biased, incomplete, and underestimate the risks. (5) The DEIS discussions of health and safety impacts of the proposed facility are biased, incomplete, and underestimate the risks. (6) The DEIS systematically underestimates and ignores certain costs of the proposed CEC, whereas it systematically overestimates and biases certain benefits of the facility.

These comments also show that the ethical assumptions underlying the DEIS and associated documents are seriously flawed in at least three respects. (1) The DEIS ignores the fact that selection of the Homer, Louisiana site would violate prima facie norms for free informed consent. (2) The DEIS ignores the fact that procedures of community solicitation used by Louisiana Energy Services (LES) violate actual norms for free informed consent. (3) The DEIS ignores the fact that socioeconomic and environmental impacts at the site will almost certainly violate norms of distributive equity. Until the DEIS addresses adequately the nine methodological and ethical flaws discussed in these comments, there is no suitable rationale for building the CEC.

1. Inadequate Arguments to Establish Need for the Facility

In accordance with NEPA requirements, the DEIS must state the need for the proposed LES enrichment facility. The DEIS claims that the LES facility will fulfil a need in the US for enrichment services that can compete successfully with foreign suppliers in the US market (DEIS, 1993, pp. 1-4, 1-5, 2-37, 2-38). The DEIS suggests that current US enrichment facilities cannot compete with foreign services

because the foreign centrifuge enrichment technology produces enriched uranium at much lower costs than does current US gas diffusion technology. In addition, citing a LES study, the DEIS states that "30 percent of the US demand for enrichment services will be uncommitted to suppliers by 1996. This uncommitted portion is expected to grow to approximately 70 percent of the enrichment demand in the year 2000" (DEIS, 1993, p. xviii). Given the higher price of enriched uranium produced by current US plants, the DEIS claims that without the LES facility, US demand for enriched uranium would be satisfied by foreign suppliers (DEIS, 1993, pp. 1-4, 2-37). As a result, states the DEIS, the US would lose both jobs and an opportunity to improve the net foreign trade balance, and there would be no reduction of dependence on foreign enrichment services (DEIS, 1993, pp. xviii, 2-37, 2-38).

However, the DEIS discussion of the need for the LES plant is inadequate for several reasons. First, the DEIS adequately considers neither the US government's current energy strategy with regard to uranium enrichment services nor what effect this strategy might have on the LES enrichment facility. The DEIS does not adequately discuss the government's plans to reorganize the DOE's Uranium Enrichment Enterprise (UEE), which is considered to be the primary reason that US enrichment services have not been able to compete successfully in the civilian market (see US Congress, 1991). It may be that the proposed LES enrichment facility is inconsistent with the US government's response to current enrichment problems. For instance, the LES facility will be in competition with DOE enrichment services, and it is questionable that such domestic competition will help the US solve current enrichment problems. Both the DOE and American taxpayers face the enormous costs of future decontamination and decommissioning (D&D), environmental restoration, and new technology deployment, but DOE customers can help taxpayers absorb these tremendous costs (see, e.g., US Congress, 1991, p. 116). Competition from the LES facility, however, would take customers away from the DOE and thus would hinder the DOE's ability to handle future expenses related to enrichment. Also, the current US enrichment strategy may destroy the viability of the LES facility. For example, the US DOE is committed to the Uranium-Atomic Vapor Laser Isotope Separation (U-AVLIS) process, a means of enriching uranium at a cost that is 50 percent lower than any other enrichment process, including the centrifuge technology (see US Congress, 1991, pp. 141-142). If the US government is able to put the U-AVLIS process in operation shortly after the year 2000 (see US Congress, 1991, p. 151) and in facilities whose production will be much greater than

the proposed LES facility, then the need for and viability of the LES facility -- which uses the less economical centrifuge technology -- may be eliminated. The U-AVLIS alternative will be discussed in more detail later. In short, the DEIS has failed to show that there will be a need for the LES facility, given current US government proposals for solving existing enrichment problems.

Another difficulty with the need for the LES facility, alleged by the DEIS, is that it adequately discusses neither the status of the US nuclear power industry nor US policy regarding the industry. The justification for building any enrichment facility seems to depend in part on the existence of a healthy nuclear industry. According to the DEIS, Energy Resources International, Inc. (1991) has projected that US requirements for enrichment services will begin to increase significantly in the year 2000 (see DEIS, 1993, pp. 1-5, 1-7). However, this projected increase is questionable because the nuclear industry in the US has been in a state of severe decline and collapse since at least the late 1970s (see, e.g., Campbell, 1988). The death of the nuclear industry in the 1970s was marked by the cessation and eventual cancellation of all orders for new commercial reactors. Although utilities ordered 231 nuclear plants through 1974, only 15 plants were ordered after 1974, and all of the latter, including over 100 other nuclear plants, were canceled or indefinitely deferred, even though many were already under construction (see Campbell, 1988, p. 3; GAO, 1989, pp. 10, 23). Also, no utility has ordered a new nuclear plant since 1978 (GAO, 1989, p. 10). Some of the reasons for the decline of the nuclear industry include: (1) a sharp downturn in expected electricity demand; (2) increased costs, brought about by inflation, construction time extensions, and unanticipated new regulatory requirements; (3) public opposition; and (4) instances of poor management resulting, in part, from over 50 utilities' building many kinds of plants (GAO, 1989, p. 14). Another important factor that currently hinders the revival of the nuclear industry is the DOE's uncertain progress in siting a permanent repository for high-level nuclear waste (see Shrader-Frechette, 1993; Lenssen, 1992; GAO, 1989, p. 4).

It is arguable that the present collapsed state of the industry will be the status quo for the foreseeable future, because many of the problems that precipitated the nuclear decline remain and show no real signs of going away. Utility officials believe that many of the difficulties that led to the collapse of the nuclear industry will persist, at least, until after the beginning of the next century (see GAO, 1989, pp. 22-25). In a 1990 report, the GAO interviewed no utility officials who were willing even to consider

purchasing a new nuclear reactor before the beginning of the next century (GAO, 1990, pp. 3, 17). Even if they eventually did purchase a reactor, no new plant would likely be on line before 2010. Moreover, reluctance to consider nuclear-generated electricity, due primarily to strong public opposition and high financial risks for utilities, is likely to continue (Lenssen, 1992).

Given the collapse of the US nuclear industry, it is questionable whether there is a real need for any new uranium enrichment facility in the US. If the DEIS is to present an adequate discussion of the need for the LES facility, then it should show, at least, that the US nuclear industry did not decline in 1974 and die in 1978. For instance, the DEIS could discuss ways to solve the problems that prevent the revitalization of the US commercial nuclear industry. Without such a discussion (and there is none in the DEIS), there is little reason to believe that additional uranium enrichment needs will be great. Indeed, at least 16 US nuclear plants have shut down ahead of schedule, either because of safety problems or citizen opposition (Shrader-Frechette, 1993, pp. 12ff., 248-249), and all but a handful of the approximately 120 nuclear plants now existing or under construction in the US will have ended their 30-to-40-year lifetime by the year 2004, long before the proposed Homer facility is expected to be completed. Moreover, even if there were significant needs for enriched uranium for US reactors, the DEIS has not established that the proposed Claiborne Center would be the most desirable way of meeting this alleged need, in part because there are alternative, more efficient, enrichment technologies as well as alternative energy sources.

2. No Adequate Exploration of Alternatives to the Facility

Although NEPA requires a detailed discussion of alternatives to any proposed facility (DEIS, 1993, p. 1-1), the DEIS provides no such adequate discussion. The DEIS states that, "The no-action alternative is the only alternative considered in the DEIS. The no-action alternative is the denial of the license application to the facility" (DEIS, 1993, p. xviii). But the "no-action" option hardly exhausts the plausible alternatives to the proposed action. Instead, the DEIS should include discussions of the status of (1) alternative non-nuclear energy sources (e.g., solar, wind, geothermal); (2) alternative nuclear energy sources (e.g., thorium-232 fission reactors (see Peterson, 1994, p. 12)); (3) alternative enrichment technologies (e.g., U-AVLIS); and (4) alternative sites for enrichment facilities. Although the DEIS states

that the "no-action" option is the only one it considered, there is a brief discussion of alternative enrichment technologies and a longer, but ultimately inadequate, discussion of the siting process.

The DEIS does not adequately discuss alternative enrichment technologies. For example, its treatment of the U-AVLIS technology mentioned earlier -- which is capable of enriching uranium at a cost that is 50 percent lower than any other technology, including the LES facility's centrifuge technology (see US Congress, 1991, pp. 141-142) -- is incomplete and insufficiently documented. The DEIS states that the U-AVLIS technology is "still being investigated and developed in laboratories in the United States and other countries and is not proven for commercial applications" (DEIS, 1993, p. 2-55). The LES also claims that

> Until DOE demonstrates integrated systems reliability, decides on a deployment plan and it is approved by Congress, there is no basis for any comparison with the CEC. (LES, 1992, p. 8)

On the contrary, LES must show that there is good reason to believe that the U-AVLIS technology will not meet current expectations. The U-AVLIS technology is well advanced, and the US is ready now to make a decision about whether to build an U-AVLIS plant. William H. Young, assistant secretary for nuclear energy, affirmed in 1991 that

> DOE's current technology demonstration efforts for the U-AVLIS process are fully funded and proceeding on schedule for completion in September 1992 to support these commercial decisions [regarding the technology's market introduction]. (US Congress, 1991, p. 142)

Furthermore, Young stated that "a small AVLIS plant with a capacity of about 3 million separative work units (SWU)" could provide "initial production in 1999" (US Congress, 1991, p. 151). Alternatively, Young claimed that a larger plant could be built "with a capacity of about 9 million SWUs at a cost of about $1,050 million, in FY 1992 dollars, with initial in production in 2000" (US Congress, 1991, p. 151). The small U-AVLIS plant would have a production capacity that is twice that of the proposed LES facility, and the larger U-AVLIS plant would have a production capacity that is six times greater. Even if the date for these U-AVLIS plants is pushed back a year or two (see LES, 1992, p. 8), if Young's expectations are met (and LES provides no reason to think that they will not), it is highly questionable whether there will be any US need for the LES facility. Also, the fact that the DOE is not pursuing the centrifuge technology is good evidence to suggest that U-AVLIS is likely to be successful. Given that the LES has given no reason to believe that the U-AVLIS technology will not meet current expectations, and given the claims of the DOE

regarding the status of the U-AVLIS technology, there is no clear need for the LES centrifuge plant in order for the US to meet its future enrichment requirements, especially because the LES plant will be in competition with a much more efficient and newer DOE technology.

The DEIS discussion of alternative sites likewise is inadequate. The DEIS screening process found three potential sites (LeSage, Prison, Emerson) suitable for detailed analysis (DEIS, 1993, pp. 2-50 through 2-56). However, all three qualified sites were located within the same Louisiana community, with two sites located less than 5 miles from each other (see DEIS, 1993, p. 2-51). Also, preliminary geotechnical, environmental, and site-specific information indicated that all three sites were very similar. Because the sites are located within the same community and share important geological, environmental, and site-specific characteristics, their designation as "alternative" sites is questionable. A much more adequate discussion of alternative sites should include detailed analysis of possible locations that differ significantly in geological, environmental, and site-specific characteristics. Furthermore, the DEIS states that "the staff and LES analyzed only the LeSage site in detail. If the impacts at the site were unacceptable, alternative sites would have been considered in greater detail" (DEIS, 1993, p. 2-55). Thus, only one site was analyzed to the degree necessary to determine its ultimate acceptability. This means that alternative sites were not analyzed in detail and compared for ultimate acceptability. Thus, the DEIS provides no adequate discussion of alternative sites. Given its incomplete analysis of alternative sites and technologies, the DEIS does not appear to meet NEPA requirements to provide detailed discussions of alternatives to the proposed action.

3. No Adequate Justification for Eliminating Potential North Carolina Sites

Another problem with the DEIS is its methodologically questionable elimination of potential areas for the site, particularly those located within North Carolina. The DEIS used a three-phased site-screening process: (1) the identification of a candidate region; (2) the determination of potential areas; and (3) the selection of alternative locations and sites (DEIS, 1993, p. 2-38). However, the screening process seems to assume that liabilities true of a region in general are also true of all the parts of that region. Given this false assumption, potential areas for the LES site may have been inappropriately excluded from consideration in the second phase of the screening process simply because they were parts of larger

regions that were eliminated during the first phase of the screening process. But what is generally true of the whole is not always true of the parts of that whole. To make this assumption is to commit what is known as the "fallacy of division" (see Copi, 1986, p. 119). For example, to argue that because an automobile is poorly built, therefore every part of the automobile is poorly built, is to commit the fallacy of division. Similarly, the DEIS may have excluded suitable areas in North Carolina merely because they were within generally unsuitable larger regions. For instance, within North Carolina there is a large investor-owned electric utility service area (i.e., the Duke Power Co.). The DEIS presents a map showing that a part of this North Carolina utility area is both within the zero seismic zone area (less than .05g) and also within the favorable wind speed area (see figure 2.10, DEIS, 1993, p. 2-45). However, the DEIS states that the "North Carolina and South Carolina utility service areas were removed from consideration because the effective peak acceleration of earthquakes exceeded $0.49 m/s^2$ (0.05g)" (DEIS, 1993, p. 2-46). Therefore, either the DEIS commits an inconsistency in the presentation of earthquake data for the North Carolina service area or the DEIS commits the fallacy of division -- in excluding the favorable part of this utility area simply because the region of which it is a part generally falls within an unacceptable seismic zone. The DEIS should either explain the apparent inconsistency or make clear how it avoids this fallacy. At a minimum, the DEIS must provide justification for eliminating the apparently favorable part of the North Carolina service area. Such a justification also would require showing that the methods used to calculate the design base earthquake (DBE) for the LES site are the same methods that were used to eliminate the favorable part of the North Carolina location. Until this is done the DEIS elimination of the North Carolina area will remain questionable.

In addition, the DEIS ignores the fact that a North Carolina site is more suitable for transportation purposes. Because the raw material source in Oklahoma is no longer operational (DEIS, 1993, p. 2-39), the favorable transportation region used in the DEIS is outdated (see DEIS, 1993, pp. 2-41, 2-45). A corrected calculation of the favorable transportation region would include the large investor-owned electric utility service area located in North Carolina and South Carolina (i.e., the Duke Power Co.). This correction makes any potential site within the North Carolina service area more favorable than Louisiana for transportation purposes, especially since this location would put the LES facility very near several destination points.

4. Biased Accident Evaluations That Underestimate the Risk

Another serious flaw in the DEIS is its biased underestimation of accident risks associated with the proposed facility. One aspect of this underestimation occurs because the Nuclear Regulatory Commission (NRC) fails to perform a probabilistic risk assessment (PRA) to determine potential risks from a variety of accidents yet makes the qualitative judgment that there is no significant risk from the facility:

> NRC staff conclude that through the combined result of plant and process design, protective controls, and administrative controls operation of the CEC does not pose a significant threat to public health and safety. (DEIS, 1993, p. xxi)

The DEIS allegation that there is no significant threat to public health and safety from the Claiborne Enrichment Center (CEC) is highly questionable and likely underestimates the real accident risk for at least three reasons: (1) no PRA was done; (2) assessors based their conclusions on largely subjective judgments formulated in purely qualitative language; (3) assessors used some very old empirical studies to draw their conclusions; and (4) assessors ignored the possibility of worst-case accidents.

Regarding the first problem, the NRC assessors admitted that their conclusion about low accident risks "was based on the proposed design of the facility" and "was of a deterministic, nonprobabilistic nature" (DEIS, 1993, p. 4-45). Drawing conclusions about safety on the basis of a proposed design of a risky facility is highly questionable because the theorized risks have not been checked empirically and hence may underestimate facility problems. Also, because virtually nothing occurs with certainty but instead with some probability less than or close to 1, and because virtually all technological hazards are currently evaluated by means of probabilistic risk assessment (see Shrader-Frechette, 1991; National Research Council, 1993), the DEIS deterministic evaluation (that accident risk at the facility is low) is highly questionable. Given assessors' well established "overconfidence bias" (see Kahneman and Tversky, 1982; Shrader-Frechette, 1993, pp. 131, 155-156), especially in assessing various nuclear-related risks, there is reason to believe that the DEIS evaluations underestimate the CEC risk. Moreover, if no PRA was done, it is impossible to confirm -- to know reliably -- that the accident risks are low. Hence the DEIS conclusion about low risks appears to beg the question.

Second, in concluding that the accident risks are not significant, the NRC assessors in the DEIS likewise appear to have underestimated the risks by virtue of the fact that they used subjective and qualitative judgments, rather than probabilistic assessments in their evaluation. They claim, for example,

that operator errors (associated with inadequate degassing of the lines) could result in dangerous "releases of relatively small magnitude" (DEIS, 1993, p. 4-52), yet they give no range of possible quantities of materials that could be released. Likewise, the DEIS assessors conclude that failure of containment in the centrifuges could result in "minor health and safety consequences" (DEIS, 1993, p. 4-53), yet they provide no quantitative analysis of all relevant and probable accident pathways and consequences. Unless they provide such a PRA, they beg the question when they claim that accident consequences are "minor." Similar instances of qualitative and subjective conclusions, including begging the question, occur throughout the DEIS. On page 4-66, for example, the assessors claim that releases of contaminants to the site will "be minimized," yet they give no specific level of contamination that will be avoided and note merely "that necessary measures will be taken to meet" established standards. Given that various types of monitoring of the site take place at a variety of intervals -- such as only once a week, once a month, and sometimes only once per year -- and given that the facility will submit the results of its environmental monitoring program to the NRC only once per year, it appears likely that accident risks and consequences will be minimized, in part because there are very few and only infrequent independent checks on facility operations.

Also, because of the largely qualitative (not quantitative) and vague discussion in the DEIS about "taking measures" to meet standards, it appears likely that the assessors minimized accident risks. Otherwise the DEIS would cite quantitative PRA data for risk levels and would guarantee that standards would actually be met, rather than that steps "will be taken" to meet standards. The DEIS likewise claims that "design, controls, and administrative procedures will be utilized to minimize the possibility of accidental releases" of contaminants from the site (DEIS, 1993, p. 4-67), and yet no specific probabilistic guarantees of minimal releases are provided in the DEIS. Hence, there is again reason to believe that the document underestimates the accident risks, in part because DEIS conclusions appear to be based on vague and qualitative judgments.

The DEIS assessors very likely also underestimated the CEC accident risks because they based their inductive conclusions about transportation risks and accident scenarios in part on old data, from 1977 and 1984, respectively, as well as on a mere proposal for facility design (DEIS, 1993, pp. 4-44, 4-45, 4-53). If data about accident risks are deterministic and inductive, then using 17-year-old and 10-year-old

data as a basis for present and future risks is likely to miss a variety of possible accident scenarios, in part because more accidents are likely to have occurred since those reported in the dated documents. Moreover, the DEIS assessors ignored some catastrophic accident scenarios (and assumed they would never occur) merely on the grounds that they had "never occurred" in 32 years of enrichment-facility experience or on the grounds that there were "redundant protection controls" (DEIS, 1993, p. 4-53). Even redundant protections, however, often fall victim to human and operator error, and 60 to 90 percent of serious technological accidents (according to the US Office of Technology Assessment) typically involve human error. Also, an alleged accident rate of 0 in 32 (years) is not necessarily low but is consistent with a rate as high as 1 in 10 or 20 years, for example. Because the US government typically regulates risks larger than 1 in 1,000,000 (Shrader-Frechette, 1991, p. 71), the possible enrichment-facility accident rate of 1 in 10 or 20 appears quite high. Indeed, the possible accident rate appears not to support the DEIS disclaimers about there being no "significant threat to public health and safety" from the CEC facility (DEIS, 1993, p. xxi).

Perhaps the greatest source of DEIS underestimation of accident risks is its failure to provide evaluations of worst-case accident scenarios. Worst-case accident scenarios likely would involve the autoclaves used in the feed and purification, sampling, and blending sections of the LES enrichment facility. As the DEIS states, "Mechanical damage or thermal over-pressurization and rupture of the feed cylinder and autoclave would produce the largest potential release to the atmosphere" (DEIS, 1993, p. 4-52). In addition, the DEIS claims,

> The product sampling and blending systems utilize heated autoclaves to liquify enriched UF_6. Failure modes for these autoclaves would be similar to those hypothesized for the feed autoclaves. Catastrophic failure of a heated cylinder and the autoclave would release a large amount of UF_6 to the atmosphere.... (DEIS, 1993, 4-53)

Nevertheless, the DEIS admits that "catastrophic failure of the blending and sampling autoclaves is not evaluated in the accident analysis" (DEIS, 1993, p. 4-53). The DEIS gives two alleged reasons for ignoring this worst-case accident scenario: (1) "catastrophic failure of a cylinder in an autoclave has never occurred with this type of autoclave," and (2) "diverse, redundant protection controls" are present (DEIS, 1993, p. 4-53). But the mere fact that a catastrophic failure has never occurred tells us nothing about how likely it is to occur in the future. The mistake here seems to be that of confusing accident frequency with

accident probability. Low accident frequency never confirms low accident probability. Accident frequency approaches accident probability only when the time period of observed accident frequencies nears infinity (Shrader-Frechette, 1991, pp. 80-81). Furthermore, the presence of diverse, redundant protection controls does not show that the accident is not likely to occur. One must first establish the effectiveness of the protection controls, and this requires in part a detailed PRA -- which has not been done. Similar objections also apply to the alleged reasons given by the DEIS for not evaluating the possible catastrophic failure of the feed autoclaves. The DEIS asserts, "Because this event has not occurred and due to the presence of diverse, redundant protection systems, the event is not analyzed in detail" (DEIS, 1993, 4-52). Thus, without sufficient justification, the qualitative, deterministic, question-begging accident studies in the DEIS provide neither an adequate analysis of worst-case accident scenarios nor the requisite PRA.

5. Biased Estimates of Health and Safety Risks

In addition to underestimating accident risks, the DEIS also underestimates the health and safety impacts of the CEC facility. The DEIS notes, for example, that groundwater contamination is a possibility from the proposed plant (DEIS, 1993, p. 4-69), yet the DEIS document provides no quantitative determination either of the groundwater risk or its associated probabilities and consequences. Nevertheless, the risk is likely to be substantial. Ninety percent of the 127 US government (Department of Energy) nuclear-related facilities have contaminated groundwater that exceeds regulatory standards by a factor of up to 1,000, and virtually every state in which a nuclear-related facility exists has criticized the federal government for not stopping health and safety deficiencies resulting from failure to obtain independent site monitoring (Shrader-Frechette, 1993, p. 155). Hence current US experience with nuclear facilities suggests both that the groundwater risk at the proposed CEC could be quite high and consequently that the qualitative DEIS judgments underestimate it. Because no PRA was done and assessors ignore the probabilistic groundwater risk, they draw vague, qualitative conclusions about its low magnitude and therefore appear to underestimate another real risk of the facility.

Assessors likewise claim that "minimal" releases of radioactive waste are expected during decontamination of the facility (DEIS, 1993, p. 4-71), yet the DEIS document provides no PRA and no quantitative determination either of this risk or its associated probabilities and consequences. Indeed,

full decontamination of a facility like the CEC has never been accomplished, so positing low risks from such an action are largely hypothetical. One important indicator that the postulated decontamination risks are greater than those postulated in the DEIS is the fact that the DEIS estimates the cost of decontamination to be approximately $518 million, even though other independent experts, estimating the cost of decontamination for other existing US enrichment facilities, have said that the cost is either unknown or may be as high as $8 billion for one plant (see US Congress, 1991, p. 194). Also, because no enrichment facility has been completely decontaminated, there are certain to be hidden, unexpected costs. These unexpected costs are likely to encourage greater risks (caused by efforts at cost control), causing decontamination costs and risks to accelerate further.

In addition to the subjective and qualitative treatment of risks from contaminated groundwater and from decommissioning, DEIS underestimates of health and safety risks occur in numerous other areas. The DEIS ignores the cumulative effect of radiological releases by virtue of its failure to calculate actual probabilistic estimates for this risk and instead dismissing it (DEIS, 1993, p. 4-66). Similarly, the DEIS admits repeatedly that the facility may not be economical (DEIS, 1993, pp. 4-75, 4-80, 4-81), yet never provides any analysis of the way that uneconomical operations typically drive plant operators to take short cuts with respect to safety. Indeed, the admissions that the plant may be uneconomical should serve as a "red flag" to anyone who believes that health and safety regulations are likely to be followed, particularly in a situation where there are no profits to fund health and safety expenditures at the facility. The admission that the plant "will continue to operate under almost any scenario" (DEIS, 1993, p. 4-82) suggests that past experience with safety violations at other US nuclear facilities will be repeated at the Homer plant, and that even environmental regulations or uneconomical operations will be ignored by CEC operators. Moreover, as already mentioned earlier, given that the NRC will review the facility monitoring program only once each year, there is reason to believe that the DEIS has underestimated the actual health and safety risks likely to occur if the plant is built.

6. Underestimation of Costs and Overestimation of Benefits

As the earlier discussion of decontamination costs reveals, the DEIS underestimates and ignores particular costs of the proposed enrichment facility, whereas it overestimates and biases given benefits

of the CEC. Surprisingly, this overestimation and underestimation appears to be systematic in such a way as to bias readers in favor of the proposed enrichment plant. For example, in the DEIS benefit-cost analysis for the CEC, numerous consequences were neither quantified and costed nor added to the benefit-cost analysis -- such as the facility's health effects, safety hazards, associated increases in nearby drug trafficking, and the worsening of the economic burdens on the lowest economic groups of persons living near the facility. Rather, such effects were discussed briefly and qualitatively and then excluded from the benefit-cost analysis. For example, the DEIS notes that the proposed plant will double background radiation to the public (DEIS, 1993, p. 4-43), that average atmospheric doses to infants (as a result of the facility) will be four times greater than that for average adults (DEIS, 1993, p. 4-40), whereas average liquid doses to infants will be ten times higher than that for average adults (DEIS, 1993, p. 4-42). Failure to include the costs associated with such effects systematically overestimates the desirability of the facility.

Moreover, as mentioned earlier, cumulative costs associated with radiological pollution, including health and safety-related effects on the workers at the facility, are not included in the DEIS benefit-cost analysis, just as various classes of catastrophic accidents are ignored both in the safety assessment and in the benefit-cost analysis. Such omissions clearly indicate that the DEIS for the CEC is far below the standards of PRA typically employed to assess proposed US facilities and that the omissions in the DEIS totally undercut its reliability. Despite all these increments of risk, including the extremely inequitable risk imposition on infants and children from the facility, and despite the fact that there is no threshold for radiation damage -- all amounts of ionizing radiation increase one's risk -- the DEIS cost-benefit calculations include no figures for the health costs of these various forms of radiation pollution. Given the fact, mentioned earlier, that the proposed enrichment plant is likely not to be profitable, DEIS exclusion of broad classes of costs suggests that the facility may be massively uneconomical, once one calculates the social costs of inequities and environmental burdens such as those just listed.

Not only does the DEIS appear to underestimate the facility costs because of its excluding many factors, but it also overestimates the benefits accruing from the proposed plant. For example, the DEIS (1993, p. 4-80) presupposes that economic benefits will flow from the proposed CEC from 2006 until 2036, even though the US commercial nuclear program actually came to a standstill in the middle 1970s. If

most US reactors will have ended their useful life by the time that the proposed CEC facility opens, then it is questionable whether many US economic benefits will flow from the plant, especially in the light of socioeconomic problems created in the region because of the facility (to be treated later). Given the problems discussed earlier with the need for the proposed plant, it appears that economically and socially victimized residents of Louisiana are being asked to bear the CEC burden of radiological damage, despite the questionable socioeconomic consequences of the facility, especially for the most disenfranchised groups of persons. Moreover, if the US nuclear industry died in the mid 1970s, as the Wall Street Journal proclaimed; if no new US commercial nuclear plants have been ordered (which have not been canceled) since 1974 (Shrader-Frechette, 1993, p. 12); and if the average commercial reactor has a lifetime of 30 years, then it must be that the proposed CEC facility will impose health and radiological risks on already disenfranchised Louisianans in order to sell enriched uranium outside the US. Later, we shall discuss more of the distributive inequities of such a scheme. The point now is that the DEIS overestimates alleged benefits of the proposed facility, even as the radiological costs of the proposed plant -- in terms of increased accidents, increased cancers, and increased genetic damages -- are not costed in the DEIS. This failure suggests both that the benefit-cost analysis is erroneous and that radiological consequences of the facility could be severe.

The DEIS also claims that many secondary economic effects will arise from the wages and construction associated with the facility, as a result of more money being pumped into the nearby Louisiana region (DEIS, 1993, pp. 4-76 through 4-79). Such multiplication of secondary economic benefits may be invalid, however, because most of the facility-related benefits will go to the middle and not lower economic classes (DEIS, 1993, p. 4-79), because crime will increase as a result of the facility (p. 4-75), because drug trafficking will increase (p. 4-80), and because property values will increase, but not in areas affected by drugs and crime (p. 4-80). If the economic benefits of the facility cause greater social inequities, more drug trafficking, and more crime, however, the "hidden economy" of the underworld may divert potential secondary benefits of the facility into crime-related activities rather than into strengthening the economy. In other words, if the regional economic infrastructure cannot utilize the secondary economic benefits associated with new construction and higher employment from the CEC, then these monies could be diverted by criminal networks to create secondary economic burdens. Meanwhile explicit

and increased government expenditures will be required to deal with problems exacerbated by the CEC. Because the additional and serious costs of drug trafficking, increased crime, exacerbated inequities, and so on, were never quantified and costed, it is clear that the DEIS has underestimated the social costs associated with the facility and overestimated alleged secondary economic benefits. Indeed, there may be an excess of secondary economic burdens. The presumed positive benefit-cost ratio in the DEIS is the product of numerous qualitative, vague, and subjective judgments, rather than the result of a comprehensive quantitative analysis. The presence of such extreme social costs as a result of the proposed plant suggests that standard multipliers for secondary economic benefits ought not be used, as they have been in the DEIS, and indeed that such standards for economic consequences, in the CEC case, may actually function as divisors for secondary economic benefits.

Apart from alleged secondary consequences, many of the claimed primary economic benefits allegedly deriving from the proposed facility are highly questionable. For example, the DEIS asserts (without evidence and without any quantification) that "for CEC most goods and services (excluding the centrifuges and related extremely specialized equipment) can probably be procured within the state" (DEIS, 1993, p. 4-75). If builders of the facility would guarantee that particular amounts of specific kinds of goods and services will be obtained within the state, then it would be reasonable to claim these goods and services as part of the benefits of the facility. Otherwise, such benefits are purely hypothetical, particularly in the light of the educational, social, financial, and industrial problems of the region and the state, problems that could undercut their provision of goods and services.

7. Violation of Prima Facie Norms for Free Informed Consent

These comments also show that the ethical assumptions underlying the DEIS and associated documents are seriously flawed in at least three respects. (1) The DEIS ignores the fact that selection of the Homer, Louisiana site would violate prima facie norms for free informed consent. (2) The DEIS ignores the fact that procedures of community solicitation used by Louisiana Energy Services (LES) violate actual norms for free informed consent. (3) The DEIS ignores the fact that socioeconomic and environmental impacts at the site will almost certainly violate norms of distributive equity. These three ethical failures revealed in the DEIS show that, contrary to the NEPA requirement to give "appropriate

consideration" to "values" (NEPA, 1970, Sec. 102. (B)), the DEIS has undercut traditional American values of equity and free informed consent.

The classical doctrine of free informed consent provides reason to believe that the siting of the LES facility in Homer, Louisiana cannot be ethically justified, and the reasons for this claim will become clearer when one understands the history of the doctrine of free informed consent. The concept of free informed consent originated in case law and medical ethics during the late 1950s when legal cases brought the concept to the attention of physicians who were concerned about the potential for malpractice suits. However, the concept of free informed consent only began to receive serious moral analysis around 1972 (Faden and Beauchamp, 1986, pp. 86-91; Beauchamp and Childress, 1989, p. 74). In the 1970s, major legal decisions, which had important implications for the concept of informed consent in clinical medicine, galvanized the interests of scholars from many disciplines and helped form a new interdisciplinary "biomedical ethics" that focused on the moral dimensions of the concept of informed consent (Faden and Beauchamp, 1986, pp. 91-93). Various other forces also fueled interest in the concept of informed consent. For instance, wider societal concerns about individual liberties and social equality, increased legal interest in the right of self-determination, increased philosophical interest in the principle of respect for autonomy and individualism, and the various issues raised by civil rights, women's rights, the consumer movement, and the rights of prisoners and the mentally ill, all influenced interest in the concept of informed consent (Faden and Beauchamp, 1986, p. 87). But most of the discussion over free informed consent centered around issues in medical ethics and not on issues concerning technological and environmental risk. Over the past two decades, two principles, protection of individual human autonomy and protection from harm, have emerged as the main grounds for justifying all persons' rights to free informed consent (Beauchamp and Childress, 1989, p. 74ff.). Today virtually all medical codes of ethics and biomedical, technological, and behavioral research codes of ethics require physicians and researchers to obtain the free informed consent of employees, patients, and subjects before undertaking any procedures (see Beauchamp and Childress, 1989, p. 74).

To see why members of the Homer community are unable to give free informed consent to the LES enrichment facility, one needs to understand the necessary requirements for obtaining free informed consent. These requirements are based on the legal and moral analyses the concept has received during

the last two decades. The concept is analyzed into four necessary components (Beauchamp and Childress, 1989, pp. 78-113; Shrader-Frechette, 1993, pp. 200ff.): (1) disclosure, which refers to the necessity professionals have to pass on facts or information to potential victims and decisionmakers; (2) understanding, which includes the duty professionals have to help persons overcome factors (e.g., irrationality, immaturity, distorted information) that can limit their comprehension of a situation to which they have a right to give or withhold consent; (3) voluntariness, which requires that subjects be free of manipulation and coercion; and (4) competence, which requires subjects to have the ability to give autonomous authorization to some act. Competence usually includes having the ability to make a decision based on rational grounds. These four requirements or norms must be met before one can obtain subjects' free informed consent.

Given the four conditions for free informed consent, there are certain types of cases in which, prima facie, requirements for free informed consent cannot be met. For example, because prisons provide a very coercive context for decisionmaking, prisoners who are promised early release in exchange for being subjects in risky medical experimentation very likely are unable to give free informed consent to the risk (Beauchamp and Childress, 1989, p. 110, 215; Beecher, 1962, p. 144-145). Requirements for free informed consent cannot be met in such cases because certain situations provide a coercive context that, prima facie, prevents the voluntariness criterion from being met. In other cases, it is doubtful, prima facie, that understanding and competence requirements can be met, as in the case of a fourteen-year-old girl consenting to a risky medical procedure in order to help her mother (Beauchamp and Childress, 1989, pp. 101). Analogously, a community's depressed economy, unemployment rate, and low level of education constitute prima facie conditions that can jeopardize its ability to meet the four standard requirements for free informed consent. Low levels of education can prevent the understanding condition from being satisfied, and a depressed economic situation can provide a coercive context that prevents the voluntariness condition from being met. Very attractive offers such as risky jobs that promise large salaries can leave persons that live within such depressed socioeconomic conditions without any alternative but to choose to accept the questionable offers (Beauchamp and Childress, 1989, p. 111; see also Shrader-Frechette, 1991, pp. 153-156). Thus, depressed socioeconomic conditions can prevent a community from meeting the four standard conditions for free informed consent.

One main ethical problem with the DEIS is its failure to take account of the fact that Homer, Louisiana, which has been selected to host the LES facility, suffers from severely depressed socioeconomic conditions and that this prima facie situation prevents the members of the Homer community from meeting the requirements for free informed consent. According to the DEIS, the per capita earnings for an average resident in Claiborne Parish are about $5,800 per year, which makes it "one of the poorest regions in the United States" (DEIS, 1993, p. 3-108). In terms of per capita personal income, Louisiana is ranked 45th in the US, and Claiborne Parish is ranked in the bottom third of Louisiana parishes (DEIS, 1993, p. 3-117). If Claiborne Parish is in a severely depressed economic condition, then this prima facie situation militates against persons having the freedom to accept or reject the LES facility, especially since the LES facility promises badly needed jobs (but few jobs for the lowest and poorest groups), high salaries, and attractive secondary economic effects (see DEIS, 1993, pp. 4-74 through 4-79). For instance, the DEIS states, "Benefits are primarily in the form of high-paying construction and operations jobs (averaging $37,000 and $37,000, respectively) in an area with average earnings about half those levels and high unemployment and underemployment" (DEIS, 1993, p. 4-74). In addition, the high school dropout rate in Claiborne Parish is 47 percent (DEIS, 1993, p. xxiii). If educational levels in Homer are low, then this prima facie situation likewise militates against residents having adequate understanding and information to give or withhold free informed consent. Furthermore, the Parish unemployment rate was 8 percent in 1991, with unemployment for minorities being twice what it is for whites (DEIS, 1993, p. 3-115). If unemployment for minorities in Homer is high, then this prima facie situation militates against their having the freedom to accept or reject a risky CEC facility that might employ some of them. Therefore, the Homer community's depressed socioeconomic condition has created a situation in which, prima facie, it is likely that neither the voluntariness nor the understanding criterion for free informed consent can be met. Because it is unlikely that the these prima facie norms for free informed consent can be met for the Homer community, it is doubtful, prima facie, that any additional imposition of serious societal risks on the community can be ethically justified.

8. LES Violation of Free Informed Consent in Solicitation Procedures

Another ethical problem with the DEIS is that LES procedures for community solicitation violate