Cost Estimate for Nuclear Regulatory Commission Licensing of Uranium Enrichment Plants at Portsmouth, Ohio and Paducah, Kentucky

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1. INTRODUCTION

The United States Senate has passed the Comprehensive Uranium Act of 1989 (S. 83) which, if it becomes law, would significantly impact uranium mining and enrichment industries in the United States. The bill, intending to ensure an adequate long term supply of domestic uranium and uranium enrichment capacity, calls for the establishment of the United States Enrichment Corporation (USEC) to take over the existing gaseous diffusion plants at Portsmouth, Ohio and Paducah, Kentucky from the Department of Energy (DOE) and operate them in a profitable and efficient manner. The bill also calls for the modification of the Atomic Energy Act so that, with the exception of export situations, enrichment facilities and related equipment shall not be considered production and utilization facilities. As a result of this modification, the gaseous diffusion plants will be subject to NRC material licensing regulations rather than facility licensing regulations. The bill directs the Nuclear Regulatory Commission (NRC) to promulgate regulations or issue other guidance for the licensing of enrichment facilities that utilize the gaseous diffusion technology. Finally, the bill requires the USEC to apply for a license from the NRC to operate the gaseous diffusion enrichment plants.

To better understand the potential implications of this legislation, the Energy and Water Development Appropriations Bill for 1990 directs the DOE, in consultation with the NRC, to conduct a study on the cost of licensing the existing gaseous diffusion plants (GDPs) at Portsmouth, Ohio, and Paducah, Kentucky, under the provisions of Senate Bill S. 83. This report presents the results of this cost of licensing study.

The licensing of the GDPs could be initiated after the NRC has completed the preparation of the licensing requirements for uranium enrichment facilities using the gaseous diffusion technology. Applying for the license will involve the (1) USEC's preparation of licensing documents to demonstrate compliance with NRC licensing requirements, (2) NRC review and evaluation of these documents to determine if the licensing requirements have been met, and (3) licensing hearings. In addition, if the existing GDPs are not capable of meeting NRC requirements, it will be necessary to modify the facilities before the NRC will grant a license.

This report presents DOE's estimate of the costs of obtaining an NRC license for the existing GDPs. Costs estimates are presented for 1) plant modifications that may be required to meet NRC requirements, 2) preparation and review of the license application documents and preparation for and participation in any necessary NRC licensing hearings.

2. COST ESTIMATE FOR POTENTIAL FACILITY MODIFICATIONS

Facility modifications required to license the existing GDPs could be accurately identified only if there were clear NRC regulations and criteria for licensing existing facilities. The Senate bill requires the NRC to develop regulations that would apply to the existing gaseous diffusion plants. In the absence of NRC regulations, facility modifications to the GDPs have been and are being planned based on DOE requirements and NRC requirements for similar facilities. These facility modifications are described below.

The Secretary of Energy has instituted policies to achieve new standards of excellence in the management and operations of DOE nuclear programs. In response to this initiative, the uranium enrichment enterprise has initiated both facility modifications (hardware) and operational improvements (manpower and procedures) in an effort to achieve the secretary's policies. Facility modifications are presently under way in the area of radiation protection as part of compliance with DOE Order 5480.11 "Radiation Protection of Occupational Workers". Seismic upgrading of the process buildings are presently under way as a result of a re-examination of the area seismicity and potential vulnerabilities of the process equipment. These upgrades will also be completed within the next several years. Other areas where projects are planned in the near future include additional process gas containment capability in the event of an accidental UF6 release, and increased uranium accountability including additional equipment for more sensitive detection for UF6 losses. It is expected that these upgrades would be required for NRC licensing and are presently under way in order to meet DOE's new standards of excellence. In the area of operational improvements, the uranium enrichment enterprise is developing a Performance Improvement Program. The primary objective of this program is to improve the standards to a level comparable to the commercial industry, provide a basis for demonstrating compliance to NRC material license requirements, and institutionalize management methods that continually strive for excellence. The cost of these upgrades and operational improvements is expected to be $90 million. It is possible that additional manpower may be required to implement these operational improvements.

As stated previously, NRC regulations do not exist for licensing existing enrichment facilities. However, NRC has issued an Advanced Notice of Proposed Rulemaking for 10 CFR Part 76 that addresses licensing of new uranium enrichment facilities. This guidance describes the staff's perceptions of the safety issues that are expected to be associated with the licensing of a uranium enrichment facility which uses uranium hexafluoride (UF6). The Federal Register announcement also proposes general design criteria that the NRC staff expects to apply to any new uranium enrichment facility it licenses. If the general design criteria for uranium enrichment plants that the NRC has proposed for new facilities were applied to the existing GDPs, it is possible that additional modifications of the GDPs could be required before the USEC could obtain an NRC license. Areas where facility improvements could be required are discussed below.

The proposed NRC design criteria for new enrichment facilities identifies the need for confinement barriers and ventilation systems but does not identify whether these requirements apply to all ventilation systems or just those systems that play a significant safety role in the event of a release. If the proposed criteria were applied to the present ventilation system, additional modifications would be necessary. In addition, NRC may require the USEC to have physical separation of the low enriched portion of the cascade from the high enriched portion in order to meet NRC material control and accounting requirements. This could require construction of additional load in and load out facilities for each portion of the cascade. Modifications to address these areas, if required by NRC, would cost approximately $60 to $110 million dollars. Additional manpower could also be required to operate in this manner.

In addition to the above two issues, the proposed general design criteria for new uranium enrichment facilities states that facilities should be designed for an earthquake with a mean return period on the order of 500 years. The proposed criteria also states that design basis earthquakes of shorter return periods could be proposed and justified through consideration of incremental risk to public health and safety relative to the 500 year earthquake. The actual response of the facility to various earthquakes was evaluated and, based on the results of these analyses, DOE-initiated facility upgrades were implemented to improve the seismic resistance of the facility so that it would be capable of withstanding an earthquake with a return period of 237 years. Since the Paducah plant has an estimated 20 years of

operating life remaining, the total earthquake risk for this facility is estimated to be the same as a new facility with a 40 year operating life that is designed to meet a 500 year earthquake. If the NRC does not agree with this approach to earthquake risk management the facility would have to be modified to withstand a 500-year earthquake. Application of the 500 year criteria to the Paducah plant would have significant cost implications.

Specific identification of the actual facility modifications, if any, that would be required by the NRC before issuance of a license to the USEC will require detailed discussions between DOE and NRC on the GDP facilities, operations, and performance analyses. DOE has been upgrading the GDPs to meet new DOE environmental and safety criteria. However, until NRC identifies what criteria it will apply to the existing uranium enrichment facilities, it is uncertain whether the DOE facility modifications are adequate for NRC licensing or whether incremental upgrades will be necessary. A cost summary of the potential facility modifications is given below.

Cost Summary of Potential Facility Modifications Associated with NRC Licensing (Thousands of FY 1990 Dollars)

	DOE Requirements	Potential NRC Requirements
Seismic Upgrades	7,000	not determined
Radiation Protection	14,000	--
UF_6 Containment/UF_6 Handling	2,000	45,000-70,000
Enclosed Uranium Handling Operations	20,000	--
Fluoride Emissions Control	6,000	--
Uranium Accountability	35,000	15,000-40,000
Other Health and Safety Requirements	6,000	--
TOTAL	90,000	60,000-110,000

3. COST ESTIMATE FOR LICENSE APPLICATION DOCUMENTS, LICENSING REVIEWS, AND HEARINGS

The cost of preparing and reviewing the NRC required licensing documents was estimated by first estimating the incremental effort to prepare the NRC-required licensing documents from existing DOE safety, environmental, physical security, and material control and accounting documents; and then estimating the cost of the NRC effort to review and evaluate the licensing documents to determine if the licensing regulations are met. Finally, the cost of public hearings that may be required was estimated.

The costs of preparing and reviewing health and safety as well as environmental documents were estimated with the help of personnel who are familiar with the existing DOE documents, the NRC review requirements, and the preparation of EIS documents. The costs of preparing and reviewing physical security and material control and accounting plans were estimated by personnel who are knowledgeable of both the measures being currently developed and implemented by DOE as well as the NRC requirements. The licensing hearing cost estimate was developed with support from personnel who have been involved in NRC licensing hearings.

NRC has never licensed a uranium enrichment facility and currently has not finalized rules specific to uranium enrichment licensing. Due to the uncertainty of the licensing process, a 100% uncertainty has been added to the total overall cost.

LICENSE APPLICATION DOCUMENTS

The license application to be submitted by the USEC is expected to include a series of documents that show that the facilities, equipment and procedures that the USEC intends to use will meet the regulatory requirements and provide adequate protection of the operating personnel, the public, and the environment. The documents that will be required to support a license application cannot be precisely identified at the present time because the regulations and regulatory guides that will establish their contents have not yet been developed. These documents will be developed by the NRC within two years after the passage of the proposed legislation. However, some estimation of the documentation requirements can be made based on an understanding of the type of documents required for other material license applications, statements by the NRC Commission Chairman recommending the modification of the Atomic Energy Act to allow licensing of the GDPs under the requirements for material licenses, and statements by the NRC staff about anticipated issues and requirements for the licensing of uranium enrichment facilities.

It is expected that the USEC will be required to prepare documents that address five technical areas. These areas are: health and safety, environment, emergency plans, physical protection of the facility and the associated nuclear material, control and accounting of the special nuclear material, and the control of classified information.

HEALTH AND SAFETY

The general requirements for license applications are provided in the regulations and additional detailed guidance for specific types of licenses is normally provided by NRC staff through regulatory guides and/or branch technical positions. The NRC staff has indicated informally that they do not expect to issue a regulatory guide specifically addressing the organization of the health and safety document for an enrichment facility license application. Instead, the NRC is expected to issue a branch technical position that will provide guidance to the applicant in the preparation of a health and safety document. This branch technical position paper will identify information required for NRC review and is expected to reference sections of the existing Regulatory Guide 3.52, Standard Format and Content for the Health and Safety Sections of License Renewal Applications for Uranium Processing and Fabrication.

Regulatory Guide 3.52 calls for the health and safety portion of the application to have two major parts. Part I, License Conditions, specifies performance requirements that the applicant proposes to commit to as conditions for receiving and maintaining a materials license. Part II, Safety Demonstration, contains detailed safety and descriptive information demonstrating the applicant's adherence to the performance requirements specified in Part I.

DOE currently requires Martin Marietta Energy Systems (MMES), the operating contractor for the gaseous diffusion plants, to develop and maintain performance requirements and safety information for both diffusion plants. The information provided in MMES-authored safety analysis reports (SARs) are similar to what is required in Part II of NRC Regulatory Guide 3.52. The MMES safety commitments to DOE, called Operational Safety Requirements (OSRs), are similar to Part I of Regulatory Guide 3.52. The existing SARs and OSRs are being upgraded to conform with current

technical standards and format. This is a four year effort estimated to cost $18 million. This cost is not included in the licensing cost estimate. Accordingly, the SARs and OSRs prepared for DOE to support operation of the GDPs can be adapted to the NRC format for submittal as the safety portion of the license application. It is estimated that changing the format and developing information requested by NRC for both the Portsmouth and Paducah GDP facilities will cost $600,000. Responding to NRC requests for additional information for both plants is expected to cost an additional $400,000.

ENVIRONMENT

NRC's regulations for implementing the National Environmental Policy Act (NEPA) are specified 10 CFR Part 51, Environmental Protection for Domestic Licensing and Related Regulatory Functions. Under normal situations applicants for material licenses are required to submit to the NRC a separate document titled Applicant's Environmental Report. Using the information provided in the applicants environmental report, the NRC would typically prepare and issue either an environmental impact statement (EIS) or an environmental assessment (EA) to support the licensing action. In this particular case, however, the Senate bill directs the USEC to prepare and submit, as part of its license application, an EIS in accordance with the requirements of NEPA.

The previous EIS documents prepared for the Portsmouth GDP in 1977 and the Paducah GDP in 1982 do not include adequate current information on the current status of the physical plants and modes of operating, the most recent environmental monitoring data, and agreements in the area of hazardous and mixed waste management. New EIS documents based on current available site data would need to be prepared. The estimated cost to prepare EISs for both GDPs is $1,600,000. This estimated cost is based on information from a contractor experienced in preparation of EISs for NRC licensing actions.

EMERGENCY PLANS

NRC regulations require applicants for special nuclear material licenses to prepare emergency plans which identify hazards that could arise at the facilities and establish procedures that would be used to protect health and minimize danger to life or property. It is expected that most of the information that

would be required by the NRC is contained in the existing emergency management plans for both the Portsmouth and Paducah facilities. It is expected that only a minor effort would be required to present this information in the manner required by the NRC, resulting in an insignificant cost relative to the other licensing costs. However, it is possible a major effort could be required to demonstrate conclusively the adequacy of emergency plans to NRC. Such an effort could cost millions of dollars.

PHYSICAL PROTECTION

The NRC requires license applicants to submit as many as three documents related to physical security: a physical security plan, a contingency plan, and a guard training and qualification plan. All three of these documents will be required for the Portsmouth facility which produces high enriched uranium, but only the physical security plan will be required for the Paducah facility which produces only low enriched uranium.

The Physical Security Plan describes in detail the applicant's program for protecting against diversion or theft of special nuclear material and radiological sabotage. Most of the requirements for security plans are presented in 10 CFR 73, Physical Protection of Plants and Materials and NUREG 0669, Physical Protection Rule Guidance Compendium. More specifically, the security plan for the Portsmouth facility will address the performance criteria listed in 10 CFR Parts 73.45 and 73.46 which require controls and procedures for access control, communications, and detection subsystems, among other criteria. The requirements the Paducah facility will have to meet are contained in 10 CFR 73.67, and are considerably less stringent.

The existing security plans for both GDPs are being upgraded and will be incorporated into DOE's Master Safeguards and Security Agreement required under revised DOE Orders for these facilities. The effort required to prepare both GDP physical security plans to address NRC requirements is estimated to be $300,000 dollars.

NRC requires that facilities processing high enriched uranium submit a safeguards Contingency Plan in accordance with 10 CFR Part 73 Appendix C. This plan establishes procedures for licensee personnel in the event of threats, thefts, or radiological sabotage. The plan presents the licensee's organized, predetermined responses to threats and identifies planned integration with other entities such as local law enforcement. It is expected that most of the information that would be required by the NRC is contained in the existing emergency management plan for the Portsmouth facility. Only a minor effort would be required to present this information in the manner required by the NRC and the cost is expected to be insignificant relative to the other licensing costs.

The last physical protection document required for the high enriched Portsmouth facility is the Guard Training and Qualification Plan. This plan, required by 10 CFR Part 73 Appendix B, will address some 100 specific areas of knowledge, skills, and abilities that each individual assigned to perform the security function is responsible for. These issues range from adversary group operations to access control systems operation. It is expected that the content of the current training program for the Portsmouth site guards is generally very similar to the NRC requirements. Only a minimal effort is anticipated to document the existing training program in a manner that supports the NRC review and evaluation and the cost is expected to be insignificant relative to the other costs of licensing.

MATERIAL CONTROL AND ACCOUNTING

The requirements pertaining to control and accountability of SNM at fixed sites and for documenting the transfer of SNM are specified in 10 CFR Parts 70 and 74. The NRC does not at this time have detailed guidance for the performance of a nuclear material control plan for a gaseous diffusion uranium enrichment plant. Rules and guidance currently are being developed for centrifuge enrichment, and NRC will prepare additional guidance specific to the GDPs.

DOE currently has a material control and accounting plan for the gaseous diffusion plants. Because of the large inventory of the facilities, the measurement uncertainties associated with the inventory estimates are larger than those associated with other NRC-licensed facilities. Discussions with NRC will be necessary in order to determine what requirements NRC will consider appropriate for the diffusion plants. An estimated $200,000 will be required to prepare material control and accounting plans for both GDPs.

PERSONNEL AND INFORMATION SECURITY

Both the high enriched Portsmouth facility and low enriched Paducah facility will require a plan for clearing personnel and safeguarding of national security information and restricted data in accordance with the requirements of 10 CFR Parts 25 and 95. This plan will describe the facility security procedures and controls for obtaining security clearances for personnel and protecting classified information through proper storage of classified material, visitor control, and protection of classified matter while in use. It is expected that the current plans and procedures for clearing personnel and protecting information could be documented in a plan that would be acceptable to the NRC for a minimum of effort, the cost of which is expected to be insignificant relative to other licensing costs.

LICENSING REVIEWS

Once the GDP license application and its associated documents have been submitted by the USEC, the NRC will conduct a review to determine if the facility and proposed operation satisfy the NRC regulations. In a typical license review, the NRC will request additional information in selected areas as topics are examined in detail. The NRC level of effort required for document review will depend on the quality and responsiveness of the original submittal as well as the additional information supplied by the USEC.

The health and safety document will be reviewed to determine if the existing facility, proposed operating organization, and mode of operation meet the regulations and provide adequate protection to the operating personnel, public, and environment. The type of issues that the NRC is expected to pay particular attention to are releases of UF6, criticality, and the ability of the facility to withstand natural phenomena. The estimated NRC staff requirements for review and evaluation of the health and safety document is at least $400,000 to $800,000 for each plant; therefore, the total cost for both plants is estimated to cost at least $1,200,000.

The environmental impact statement submitted by USEC as part of its license application will be reviewed and evaluated by the NRC against 10 CFR Part 51. It is assumed that NRC will thoroughly review the draft EIS and submit comments to the USEC and that USEC will adequately respond to all NRC comments in the final EIS. The NRC staff should then be able to adopt the EIS. It is estimated that the NRC will spend at least $40,000 to review each EIS.

The documents that describe the emergency plans for the GDPs will be reviewed and evaluated by the NRC staff. The cost for this review specific review is expected to be minimal in comparison to the other NRC review costs.

The documents that describe the USEC plans for providing physical protection will be reviewed and evaluated by the NRC staff. The review and evaluation of the Physical Security Plan, Contingency Plan, and Guard Training and Qualification Plan required for the Portsmouth facility are expected to cost about $300,000. The simpler Physical Security Plan for the Paducah facility is estimated to require about $50,000.

The USEC Material Control and Accounting Plan will be reviewed by NRC to determine if it meets the applicable regulatory requirements of 10 CFR Parts 70 and 74. The additional rules and guidance expected to be developed by the NRC specifically for the GDPs are not yet available. However, assuming that the USEC will submit a plan that meets most of the future requirements, the estimated level of effort required for the NRC to review the Material Control and Accountability Plans for the Portsmouth plant is $200,000. The effort for the review of the Paducah Material Control and Accountability Plan is estimated to cost $50,000.

The cost of the NRC review of the plans for clearing personnel and safeguarding national security information and restricted data, submitted in accordance with 10 CFR Parts 25 and 95, will not be charged to the USEC. However, the costs for transferring clearances from DOE to the NRC will be incurred by the USEC. These charges can range from tens to thousands of dollars per security clearance transferred. The transfer of two to three thousand security clearances from DOE to NRC could cost as much as several million dollars.

HEARING

Unlike the licensing of a reactor facility, there are no mandatory hearings prior to the issuance of a materials license; however, the Atomic Energy Act of 1954 requires that NRC afford an interested person, upon request, a hearing in any proceeding for granting, suspending, revoking, or amending an NRC license, including a materials license. Accordingly, NRC materials licensing staff offers an opportunity for a hearing prior to taking significant licensing actions or actions where there is considerable public interest.

The rule that prescribes the procedures to be followed in a hearing related to a materials licensing action is specified in 10 CFR Part 2, Subpart L, Informal Hearing Procedures for Adjudications in Materials Licensing Proceedings. This rule defines hearing procedures that differ substantially from 10 CFR Part 2, Subpart G, which are for formal trial-type adjudications. Specifically, in these material licensing types of hearings, the presiding officer is to receive and make a determination based solely upon a "hearing file" compiled by NRC staff and written presentations by the parties. Oral presentations are not allowed unless the presiding officer finds that the written presentations are insufficient to create an adequate record. Any examination

of those making oral presentations is limited strictly by the presiding officer. The type of cross examination that is generally permitted in formal adjudications is prohibited. Essentially, the informal hearing is designed to elicit information and resolve issues primarily through inquiry by the presiding officer rather than through an adversarial process between the parties.

The estimated cost for a hearing is highly uncertain and variable. It will depend upon the number of intervenors and the number and complexities of the contentions. Based on similar materials licensing hearings, it is estimated that if a hearing were required it could cost in the range of $300,000.

A summary of the costs for preparation and review of the licensing documents and preparation for hearings for both gaseous diffusion plants is presented in the following table.

Cost Summary for Preparing and Reviewing Documents for NRC Licensing of the USEC Gaseous Diffusion Plants* (Thousands of FY 1990 Dollars)

Licensing Topic	USEC Costs	NRC Costs
Health and Safety (SAR and OSR)	19,000	1,200
Environmental (EIS)	1,600	80
Physical Protection	300	350
Material Control and Accounting	200	250
Hearing	150	150
Subtotal	21,250	2,030

Total	23,280
50% Uncertainty	11,640
Total plus Uncertainty	34,920

*Summary does not include costs for transfer of personnel clearances from DOE to NRC or for any potential facility modifications that may be required.

4. SUMMARY

In summary, there is a large uncertainty in estimating the cost required for potential facility modifications which may be required for licensing. This is due to the fact that it is not known what criteria will be used to license the existing facilities. DOE is presently conducting modifications which total $90 million. Potential requirements identified in 10 CFR Part 76 for new enrichment facilities could require additional costs ranging from $60 to $110 million. There is also the potential that even larger costs due to facility modifications may be necessary depending on what criteria NRC finally uses to license the existing facilities. Therefore, it is estimated that a reasonable expected cost of facility modifications and operational improvements for licensing the existing facilities would be in the range of $150 to $200 million dollars with the potential for larger costs depending on what criteria NRC uses for the existing facilities. Additional manpower may also be required to implement these criteria.

The estimated cost of preparing and reviewing the documents and preparing for hearings required for NRC licensing of USEC owned gaseous diffusion plants is $23.3 million dollars. However, there are significant uncertainties associated with this estimate because the regulatory requirements that are expected to be used for licensing GDPs have not been specified, and the Commission, while it does have experience licensing facilities which handle significant quantities of natural and enriched UF6, lacks experience licensing enrichment facilities. Because of these uncertainties, a 50% contingency has been included in the cost estimate. Therefore, the total estimated cost of preparing and reviewing licensing documents and preparing for licensing hearings is $23 to 35 million dollars.

The major characteristic of the total cost estimate of NRC licensing of the existing GDPs is its uncertainty. The cost could be as high as $235 million dollars if significant facility modifications are required in order to meet NRC licensing requirements. Conversely, the costs may be as low as 23 to 35 million dollars if no major modifications are necessary and if only the preparation and review of various licensing documents are required. To reduce this large uncertainty in potential costs, NRC and DOE need to conduct discussions on the licensing criteria that would be applied by NRC and on potential facility modifications that would be required to meet these criteria.