DOE/OR/21555--T8

Received by OSTI
APR 20 1992

Final Report

Environmental Impacts

of

Proposed Monitored Retrievable Storage

by

Tennessee Department of Health and Environment

December 17, 1985

FG05-85OR21555

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DE92 011930

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As coordinator for the evaluation of the MRS proposal, I would like to express my appreciation to Suzanne Haegert, program coordinator for the Bureau of Environment, for her assistance in arranging meetings, handling logistics, and editing this final report.

I would further like to extend appreciation to the staff of S.A.I.C., Inc., for their assistance in the delivery and distribution of some of the voluminous documents connected with this project.

Wayne K. Scharber

GRANT COORDINATION AND PARTICIPATION IN ENVIRONMENTAL IMPACT EVALUATION OF MRS PROPOSAL

Prepared by Wayne K. Scharber, Director of Environment
Tennessee Department of Health and Environment
150 Ninth Avenue, North
Nashville, Tennessee 37219-5404

The Coordination role began with considerable intensity following the first meeting with U. S. Department of Energy (DOE) officials on April 26, 1985. Governor Lamar Alexander and his Safe Growth Cabinet Council, chaired by Commissioner James E. Word, identified four major points of concerns for the proposal. Those concerns were (1) health, safety and transportation; (2) economic impact; (3) attitude of the local community; and (4) role of the state. It was immediately recognized that a multi-agency review would be necessary in developing information to assist the Governor in making a decision on the proposal.

All of the departments represented by the Safe Growth Cabinet Council, which includes the Departments of Health and Environment, Transportation, Economic and Community Development, Conservation, Agriculture and the Wildlife Resources Agency were asked to submit brief proposals reflecting their agency needs in evaluating the proposal. Additionally, other state agencies, included in this solicitation for proposals, were the Department of Tourism, Public Service Commission, Office of the Attorney General, Emergency Management Agency and the local governments at the three identified sites. Fifteen proposals were obtained, and a grant application in the amount of \$2,035,182 was submitted to DOE. The task proposals were reviewed by the state and DOE, and a grant of \$1,404,533 was negotiated and awarded. The approved grant included ten task proposals.

The tasks pursued included an economic assessment relating to its influence on jobs, property values, infrastructures and local anomalies. Also, this economic assessment reviewed perception attitudes which could impact tourism industry or other new industry considering a Tennessee site location. The economic assessment was supervised by the Economic and Community Development Department and was conducted by the University of Tennessee.

The Tennessee Public Service Commission, Emergency Management Agency and Department of Transportation reviewed routes, pursued training and information exchange and planned for regulation needs to assure safe routes and safe transportation via rail and highway. The Attorney General's office was involved to assure that the rights of the state were not lost and to give assistance and legal advice as state agencies proceeded with their evaluation.

The Department of Health and Environment had many programs involved in review of the plans for radiological safety in plant design and transportation plans, operation safeguards and case designs. These concerns were not only for the employees of the MRS but the citizens of the state. Also included were analysis of staff needs for monitoring and enforcement for compliance with standards established by NRC in the operation, decontamination and decommissioning of the

facility. Limited reviews have been made of existing health data in the local communities and an identification of the background health data needed prior to operation of an MRS. The Department has expressed concern and continues to identify activities relating to water supplies, water pollution and emergency planning to address incidences which may impact these areas. The greatest part of this task will be during EIS if the MRS is authorized by Congress.

The Department of Conservation has been involved in providing oversight of the EA process and has reviewed the limited geologic data that has been available for the three potential sites. Considerable activity will be pursued during EIS regarding flora, fauna and the potential effects on the natural communities.

The Department of Health and Environment entered into contracts with the local communities to share grant funds with them to allow them to pursue an "unrestricted" evaluation locally. The findings and/or comments will be considered by the Cabinet Council for briefing the Governor. The Department made initial contact to members of the Tennessee General Assembly and has shared all information with members so that they have the same information as the Governor for making his decision.

The "third party" technical assessment was led by the Safe Growth staff, utilized a Commissioner-appointed "Radiological Waste Technical Advisory Panel," and contracted with the University of Tennessee and Vanderbilt University.

Those proposals which were deleted will need to be fully addressed during the EIS period if the MRS is authorized by Congress.

The role of coordination also provided an interface to DOE for information exchange, scheduling of meetings/workshops and a distribution point for expanding data being generated by DOE. The staff of DOE has been extremely responsive in providing available information for distribution. The Department of Health and Environment has established a complete library/reading room available to the public which contains all of the information available on the MRS subject. Meetings have been open to the press, and considerable press coverage had been experienced across the state, but primarily in middle and east Tennessee. The role of coordinator included sharing information with the Legislature. In early May when the Cabinet Council and the Public Service Commission were being briefed by DOE officials, arrangements were made for selected members of the Legislature, those representing the immediate communities where the three proposed sites were located, to likewise be briefed. That briefing had limited participation, however, a resolution, Senate Joint Resolution 183, was introduced and passed which created a six-member legislative committee to review the proposal and report its finding in January 1986.

Following the grant award, budget revisions for the various agencies involved were submitted to the Legislature and approved. Numerous meetings were held with agency representatives to consummate contracts for the various proposals. Meetings were held with local community officials to discuss the proposal, evaluation process and to assure non-duplicative reviews.

Numerous meetings were held between Department of Health and Environment officials and DOE officials. The Attachment I is a chronological listing of these meetings. In addition, the role of coordinator included briefing meetings with Governor Alexander or his staff.

The last series of public meetings conducted by the Safe Growth Cabinet Council were held in Chattanooga, Knoxville, Lebanon and Memphis to inform the public of the state's evaluation results. Attachment II is a summary from the Bureau of Environment presented at these meetings. The turnout at these meetings was small, but the public which was present was in general opposition to the MRS proposal.

SUMMARY

PROJECTED COSTS TO THE BUREAU OF ENVIRONMENT

1 Project Coordinator (Public Health Administrator)	\$ 67,000	
1 Programs Coordinator	<u>48,600</u>	
Salaries and benefits	\$ 115,600	
Travel and related costs	<u>24,400</u>	
Subtotal		\$ 150,000
Design/Consultation for Health Study	\$ 750,000	
Health Study	<u>1,000,000</u>	
Subtotal		\$1,750,000
Radiological Health		
Staff salaries and benefits	\$ 329,539	
Travel and related costs	<u>110,000</u>	
Subtotal		\$ 439,535
Annual Costs	Grand Total	<u>\$2,339,535</u>

**CHRONOLOGY OF MEETINGS (WITH STATE AND DOE PARTICIPATION) WITH LOCAL AGENCIES
OR PUBLIC RELATION TO THE DOE MRS PROPOSAL**

DATE	TYPE AND PURPOSE OF MEETING	STATE ATTENDEES*	DOE ATTENDEES*
4/26/85	Briefing on MRS Announcement Nashville	Word, et al	Hilley, et al
5/9/85	Briefing for Cabinet Council and Public Service Commis- sioners, Nashville	Word, Eskind, Cockran, Bissell, Farris, Howell, Myers, et al	Hilley, et al
5/9/85	Briefing for Legislators Nashville	Word, Burkes, Elkins, O'Brien, Wheeler, McNally, Henry, et al	Hilley, et al
5/23/85	Briefing for PSC staff Nashville	Scharber, Bissell, et al	Barrett, et al
6/5-6-7/85	Grant application and review and OR field trip, Oak Ridge	Scharber	Carlson, Gross, et al
6/9/85	Briefing to TN Municipal League, Jackson	Scharber, et al	Klein, et al
6/12-13/85	Briefing on EA approach/ proposal, Nashville	Scharber, et al	Gross, et al
6/14/85	Briefing/meeting to discuss MRS with Hartsville area officials and citizens Hartsville	Scharber, et al	Hilley, et al
6/15/85	Congressional community hearings/meetings - Lloyd and Gordon, Kingston and Cookeville	Word, Scharber, Eskind, Cockran	Hilley, et al
7/9-10/85	Briefing/workshop on MRS package, Nashville	Scharber, et al	Klein, et al
7/10/85	TN Environmental Council Public Meeting, Nashville	Scharber, et al	Klein, et al
7/11/85	Briefing on State Workshops with Hartsville area officials and citizens, Hartsville	Scharber, et al	Klein, et al

*"et al" means junior staff for Word or for Hilley or the person listed

DATE	TYPE AND PURPOSE OF MEETING	STATE ATTENDEES*	DOE ATTENDEES*
7/18/85	Briefing on State Workshops with Clinch River area officials and citizens Oak Ridge	Scharber, et al	Carlson, et al
7/18/85	NRC/DOT Transportation Chicago	Scharber, et al	Barrett
8/12-16/85	Field trip to Western facilities of DOE - Idaho, Nevada, New Mexico	Word, Eskin, et al	Hilley, et al
8/20/85	Cabinet Council - public hear- ings, Chattanooga; included presentation of MRS proposal by DOE and TN	Word, Eskin, et al	Klein, et al
8/22/85	Cabinet Council - public hear- ing, Knoxville; included presentation of MRS proposal by DOE and TN	Word, Eskin, Cockran, Myers	Klein, et al
8/29/85	Cabinet Council - public hear- ing, Lebanon; included presentation of MRS proposal by DOE and TN	Word, Eskin, Cockran, Myers, Howell, et al	Klein, et al
9/5/85	Cabinet Council - public hear- ing, Memphis; included presentation of MRS proposal by DOE and TN	Word, Eskin, Cockran, Myers	Klein, et al
9/21/85	Meeting with League of Women Voters on MRS proposal - Pickwick State Park, TN	Scharber	Gross
9/26/85	Clinch River MRS Task Force Workshop on committee evaluation/reports, Oak Ridge	Scharber	Gross
10/2-3/85	Clinch River MRS Task Force briefing on evaluation findings with TN Congressional staff, DOE staff and NRC staff - Washington, D.C.	Scharber	Rusche, et al

*"et al" means junior staff for Word or for Hilley or the person listed

DATE	TYPE AND PURPOSE OF MEETING	STATE ATTENDEES*	DOE ATTENDEES*
10/9/85	Discussion of spent fuel transportation plans Nashville	Word, et al	Barrett, et al
10/21-22/85	Spent fuel transportation seminar - Springfield, Ill.	Scharber, et al	Barrett, et al
11/15/85	Public Hearing, Hartsville	Scharber	
11/18/85	Draft EA review/workshop Nashville	Scharber, et al	Klein, et al
11/19-21/85	Transportation Institutional Plan Workshop - Atlanta	Scharber, et al	Rusch, Barrett, et al
12/2/85	Legislative Public Hearing Nashville	Scharber, et al	Gross, et al
12/3/85	Cabinet Council - Public meet- ing - Chattanooga - State's Evaluation Results	Howell, Scharber, et al	Klein, et al
12/5/85	Cabinet Council - Public meet- ing - Knoxville - State's Evaluation Results	Howell, Scharber, et al	Gross, et al
12/6/85	Clinch River MRS Task Force Oak Ridge	Scharber, et al	Rusche, Hilley, et al
12/10/85	Cabinet Council - Public meet- ing - Lebanon - State's Evaluation Results	Scharber, et al	Gross, et al
12/12/85	Cabinet Council - Public meet- ing - Memphis - State's Evaluation Results	Scharber, et al	Gross, et al
12/17/85	Transportation routing workshop - Nashville	Scharber, et al	

The above listing only reflects meetings at which DOE was present to participate or discuss in any way the MRS personnel.

*"et al" means junior staff for Word or for Hilley or the person listed

PRESENTATION TO SAFE GROWTH CABINET COUNCIL

November 22, 1985

Wayne K. Scharber

Other areas of the Bureau of Environment in addition to the Division of Radiological Health have been involved in the state's evaluation of the proposed MRS. As you all know our program areas are primarily regulatory; therefore, if the MRS is sited in Tennessee, an increase in work would be placed on the divisions. The following represents a summary of individual program reports.

The Division of Air Pollution Control, having reviewed the information submitted by DOE, has identified several potential air contaminant sources which may be subject to permits and subsequent regulatory monitoring. The sources identified are:

1. Steam boilers burning fossil fuel.
2. Concrete batch plant, including processing equipment, storage sites, storage stockpiles and unloading stations.
3. HEPA filter controls for the hot cells and the one proposed exhaust stack.
4. #2 diesel oil storage tank(s).
5. Four standby power diesel-engine-driven generators and one standby diesel-engine-driven firewater pump.
6. Miscellaneous storage tanks or process tanks.
7. Vehicular emissions from engine exhausts.
8. Construction activities.

The Division at this time and based upon conceptual design and environmental assessment information believes the MRS could operate in compliance with state standards and permit conditions and any emissions would have no significant impact on air quality.

The Division of Water Pollution Control has concluded that the MRS will not discharge radioactive contaminated wastewater. The non-radioactive process wastewater, domestic wastewater, and, during construction and operation, the surface drainage waters will all be regulated by NPDES permits issued by the state and such can be done with discharge in compliance to either the Clinch or Cumberland River.

The Division of Water Supply would review and approve for construction plans for water lines and storage tanks expansions proposed for the MRS. Should any treatment plant operation or expansion be planned, it would also be subjected to the review and approval process. If the MRS is authorized by Congress and it is

approved for siting in Tennessee, we would want to develop an inventory of water supply intakes downstream from the site as well as any stream crossing points on the routes to and from the MRS. This information would be most useful in the unlikely event of major accident.

The Division of Solid Waste Management would also have some regulatory role, and, based upon present information, does not foresee any problems.

The Ground Water Division has reviewed information and believes that the engineered facility above ground will not cause or contribute to ground water problems.

Another area within the Bureau with a substantial role and concern is our Environmental Epidemiology Section. The NWPA provides in Section 117(c) (5) for conduct of baseline health studies of inhabitants in neighboring communities near the MRS site and reasonable periodic monitoring thereafter. A problem at this point in time is that there are no accepted standard means of assessing health of a population nor is there a plan for subsequent monitoring of the population. There have been several research models developed in the past, and one example is the famous "Framingham Study" which followed the population of the Massachusetts town for 24 years to determine factors which produced heart disease. Such studies are very expensive in time, efforts and funds.

To begin the process of developing methods for assessing the health of the people in the surrounding community, we must first find a group of creditable, wise, and experienced experts to arrange a design for such a study. The design must be practical to perform, acceptable to the examinees, and meaningful in results. It must stand the test of time -e.g., 50 years. Perhaps, the National Academy of Medicine (of the National Academy of Sciences) or another creditable consortium of wisdom might address the problem. Funds are essential for consultation in this matter. Then "megabucks" will be required for the ongoing assays.

Based upon the preceding findings of safety and subjection to environmental regulations, I believe the Department should proceed to build upon the Clinch River MRS Task Force report of "acceptance with conditions". Specifically, we should condition a clear regulatory authority, fully staffed and supported by funds from the MRS. The funding for the regulatory staff and the baseline health study should become available with the authorization by Congress and be very specifically delineated in the C & C agreement.

Tennessee has not had the benefit of local acceptance of sensitive issues, such as new prisons, chemical hazardous waste sites, low level radioactive waste sites, or occasionally sanitary landfills. As several have now acknowledged the technology is there and now the local acceptance is there, we should adamantly insist and assure the credibility and the "will" to properly operate an MRS is there. I believe further the best time to do some of this is on the front end as DOE is finalizing its proposal and prior to Congressional action.

We should push extremely hard on the DOE that those existing sins-of-the-past be corrected even though they are not MRS related but such would be a very strong show of willingness to comply and more significantly a genuine concern for the health of the people and for environment of the state.

IMPACTS OF MRS UPON WATER SUPPLY

Based upon participation in the MRS conferences and review of the Environmental Assessment parts available, several conclusions have been reached concerning MRS impact on public water supplies.

Radioactive contamination of public water system raw water sources by MRS activities is very unlikely. In the event an MRS should be approved, an inventory of public water systems downstream from the MRS location must be conducted. In addition, there would need to be an inventory of the public water systems downstream from interstate highway and railroad crossing points throughout the state. This information would be used to make emergency plans for the unlikely event that an accident should contaminate the area near the MRS, including the streams, or that an accident involving transport of radioactive waste could contaminate a stream should the accident be at or near a highway or rail stream crossing. (The remote possibility of a transportation accident contaminating a stream should be planned for even if the MRS is not approved.)

Water demand during construction of an MRS is estimated to be not more than 225 gallons per minute (gpm) at any moment. During operation of an MRS facility, water use is estimated to be about 350,000 gallons per day at summer cooling rates. This would probably require expansion of water treatment plant capacity. The State's role would include review and approval of plans and specifications along with occasional field inspections during construction of required projects. From a public water supply standpoint, the impact of a MRS would be minor.

H. A. Macintire

IMPACTS OF MRS UPON WATER POLLUTION CONTROL

MRS proposes no discharge of wastewater contaminated by radioactivity. It is proposed that waters from spills, fire control, etc., will be treated through the radioactive waste treatment system which has no discharge.

Non-radioactive process wastewaters will be generated by way of cooling tower blowdown, steamboiler blowdown, and manufacture of storage casks. Chemical-physical treatment is proposed to meet applicable standards. This will be regulated through NPDES.

Collection and treatment of surface drainage during the construction and operation phase is proposed. These waters are subject to storm water runoff provisions of NPDES. Only typical runoff pollutants are expected.

The domestic wastewater is to be treated according to a plan set out in the EA which appears to be tertiary level. Due to the fact that the anticipated volume is to be about 14,000 gallons per day, a secondary treatment would be acceptable to the Cumberland or Clinch River. This would also be regulated under NPDES. The amount of water to be withdrawn from either river is negligible.

In summary, the proposed activity is acknowledged by DOE to be subject to state regulation via NPDES. The MRS facility operating as planned will be no more of a water quality problem than any of the numerous other discharging industries in the state.

Paul E. Davis

IMPACTS OF MRS UPON GROUND WATER PROTECTION

Based on information provided by the Department of Energy, the proposed facility will consist of above-ground, engineered processing and storage facilities. The evaluation has led to no significant concern for the potential for ground water contamination. However, it is recommended that the field drywell storage concept should not be used; otherwise, concern for ground water impacts may need to be re-evaluated.

Terry K. Cothron

IMPACTS OF MRS UPON AIR QUALITY

Some particulate monitoring sites at the DOE Oak Ridge facilities have indicated particulate ambient air concentrations in excess of levels allowed by the standards. These monitors are located approximately 3 miles from the Clinch River site. These sites are operated by DOE and have not been quality assured by the Division of Air Pollution Control. The Division is presently checking on operation of these monitors by DOE. It is not anticipated that the proposed MRS operations would have a significant impact at the DOE monitor location.

The construction of some major stationary air contaminant source in the Clinch River site area could consume all or a large part of the available PSD/pollutant (Prevention of Significant Deterioration) (TSP, SO₂) increment for the area making permitting of the MRS difficult. An air quality analysis for the site would be necessary to determine the available increment. This is pointed out as a possible, not probable, concern.

The air contaminant sources at the proposed MRS facility are basically as follows:

- (1) Steam boilers burning a fossil fuel
- (2) Concrete batch plant including processing equipment, storage silos, storage stockpiles, and unloading stations.
- (3) R & H building from the hot cells; HEPA filter controls with one proposed exhaust stack. Total suspended particulates should be negligible for this source. Radionuclides are another issue, but do not appear to be excessive for this source.
- (4) #2 diesel oil storage tank(s)
- (5) Standby power diesel-engine-driven generators: these generators may be subject to a PSD review depending on maximum fuel consumption rate. Nitrogen oxide and carbon monoxide emissions would be the pollutants likely to cause the need for this review. Four generators are proposed. A PSD review could be avoided by establishing legally enforceable permit conditions since the generators are only for standby operations. There is also a proposed diesel-engine-driven standby firewater pump.
- (6) Miscellaneous storage tanks or process tanks.
- (7) Vehicular emissions from the engine exhaust: Air Pollution Control does not presently regulate mobile sources, but their impacts would be evaluated for significance.
- (8) Construction activities: The emissions from construction activities are not considered part of the permit review process. However, emissions from temporary activities such as this can definitely affect air quality in the immediate area. Fugitive particulate emissions would be of the most concern.

IMPACTS OF MRS UPON SOLID WASTE MANAGEMENT

Solid Waste Management regulations exclude source special nuclear or by-product material as defined by the Atomic Energy Act of 1954. Disposal of low level radioactive waste material would be handled through the Regional Compact. However, the Division would be involved in the disposal of "Solid Waste" (garbage, refuse) as it related to coordination with the local sanitary landfill operation.

In addition, the Division could become involved in the registration of a demolition site for inert materials such as construction debris, etc., if necessary and, upon notification by the facility, could become involved in the regulation of hazardous waste. This would include areas such as generator inspections and issuance of operation permits.

Norman Travis

IMPACTS OF MRS UPON ENVIRONMENTAL EPIDEMIOLOGY

The primary interest of Environmental Epidemiology is protection of the health of the people of Tennessee.

The Nuclear Waste Policy Act (NWPA) provides in Section 117(C)(5) for conduct of baseline health studies of inhabitants in neighboring communities near the MRS site and reasonable periodic monitoring thereafter. The people within a radius of 50 miles of the proposed facility are included.

The problem is that there are no accepted or standard means of conducting baseline health studies of a population; nor is there a plan for "reasonable periodic monitoring thereafter" of populations. There have been several research models developed in the past. One example is the famous "Framingham Study" which followed the population in Framingham, Massachusetts, for 24 years to determine factors which produced heart disease. Such studies are very expensive in time, effort and funds.

To begin the process of developing methods for baseline health studies of the people living nearby to any of the three proposed MRS sites in Tennessee, a group of creditable wise and experienced experts to design such a study must be contracted. The design must be practical to perform, acceptable to the examinees and meaningful in results. It must stand the test-of-time, e.g. 50 years. Perhaps, the National Academy of Medicine (of the National Academy of Sciences) or another creditable consortium of wisdom might assess the problem. Approximately \$750,000 would be needed to fund the design process.

The Tennessee Department of Health and Environment facilities and personnel could be utilized in a devised plan but the public, medical and scientific communities might not accept it. An authority of great prestige will be required.

Funds are essential for consultations on the matter, and approximately \$1,000,000 per year will be required for the ongoing health studies and monitoring. All of this should be included in the cost of MRS.

George Walter

**REPORT ON THE
DEPARTMENT OF ENERGY'S
MONITORED RETRIEVABLE STORAGE (MRS) PROPOSAL**

BY

**THE DIVISION OF RADIOLOGICAL HEALTH
TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT**

DECEMBER 17, 1985

Prepared by:

**Michael H. Mobley
Debra G. Shults
Roger L. Halsey
Elizabeth F. Gilley**

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I. Introduction

The Division of Radiological Health, Tennessee Department of Health and Environment, as part of a State task force has been instructed to evaluate the Department of Energy's proposed Monitored Retrievable Storage (MRS) facility. This Division is uniquely qualified for this task as it is the State of Tennessee's counterpart to the Nuclear Regulatory Commission and the radiation activities of the Environmental Protection Agency and routinely deals with numerous and varied activities involving radiation. Education, training, and experience received in licensing, inspecting, and responding to emergencies at facilities similar to the proposed MRS was very beneficial in evaluation of the proposal. Also invaluable was the training received in nuclear power plant operations and necessary emergency response activities pursuant to the operation of such facilities, e.g., emission release modeling, dose impact assessment, nuclide inventory in active or spent fuel, etc. We have been asked to evaluate and assess the preliminary facility design of the MRS facility, the radiological impacts from both transportation of spent nuclear fuel and the operation of such a facility, and the impacts to this Division if a MRS facility were to be sited in Tennessee. With these goals in mind, we have reviewed several thousand pages of material, attended meetings with DOE staff, attended public meetings across the State, traveled to DOE facilities in Idaho, New Mexico and Nevada to observe nuclear operations, attended transportation seminars in Chicago, Illinois, Springfield, Illinois and Atlanta, Georgia and an individual from this Division served as a member of the Radioactive Waste Technical Advisory Panel.

The information needed to fully evaluate and license a facility of this magnitude has not been presented to the State and much of this critical information has not yet been developed. Therefore, we have evaluated this proposal based on preliminary information, concepts that have been presented and our knowledge of the ongoing research and development and existing technologies in the nuclear industry. The Department of Energy has not sufficiently answered some questions presented to them by this Division and several specifics have not been outlined as yet. Based on this lack of information, this evaluation should not be construed as being all inclusive but rather an impression of intent of the DOE.

II. Facility Design

The conceptual design proposed for the MRS facility and outlined in the "Integral Monitored Retrievable Storage (MRS) Facility, Conceptual Design" prepared by the Ralph M. Parsons Company for the Department of Energy appears to be adequate for the protection of personnel at the facility and for the surrounding population from radiation. The occupational exposure is estimated to be less than 1.25 rem per year which is one quarter of the annual limit allowed by State and NRC regulations. The additional radiation exposure to the surrounding population is estimated to be less than one millirem per year from normal MRS operations. This would add approximately 1% to the existing natural background radiation in both the Oak Ridge and Hartsville areas. It has been our experience in evaluating radiation facilities that due to engineering and health physics conservation

most facilities are overdesigned. Thus facilities designed for occupational exposure of 5 rem per year achieve exposures of 1/10 the design. DOE made use of ALARA, as low as reasonably achievable, a basic premise of health physics protection to promote even greater reduction in occupational exposures.

One caution or concern with regard to facility design (and procedural design) is that elaborate or intricate solutions to unique situations may sometimes result in more exposure to individuals although at a lower rate, e.g., it may be better in some instances to take a higher exposure rate to facilitate an operation (do it faster) than it is to lower the exposure rate via some means but increase operation time. The end result may be more exposure for the worker.

The on- and off-site monitoring systems proposed for this facility are more than adequate and the redundancy of these systems is an additional safety design feature. Exposure control is mentioned throughout the "Conceptual Design Report" as are shielding structures, alarm systems, and effluent control. The quality assurance program proposed for these systems would be an added assurance that any abnormal releases of radioactive materials would be quickly detected. The above ground storage design has inherent safety features that make it preferable to the field drywell concept.

III. Fuel Rod Consolidation

Of all the activities proposed for the MRS this one is the one that concerns us the most. It is the activity that presents the greatest potential and probably the largest real source for occupational exposure. The greatest exposures will not come from the actual operation but from cleanups of hot cell areas necessitated by maintenance or other activities requiring personnel entry into contaminated areas. The routine operation should pose little hazard to workers or the public. It is clear that further developmental work on the process is necessary, however, the handling of highly radioactive and radioactive contaminated materials has been done in hot cells for many years. Process equipment to mitigate or contain contamination can be developed. One example of this is the spending of over one million dollars and three attempts by one of our licensees to contain and robotize an operation to control and reduce worker exposure.

Another area of concern in this particular process is the criticality concern. Any handling of nuclear fuel must be done with an appreciation for the potential of nuclear criticality. DOE has addressed this, however, it is not clear that all concerns have been adequately addressed at this time.

The approach taken by DOE in air handling is typical for radiation facilities in that the basic facility is maintained at negative pressure to the environment and each successive controlled area (controlled for purposes of radiation protection) is at a negative pressure to a lesser controlled area. This results in minimal spread of any airborne contamination from interior areas. Air is then filtered and exhausted. Some areas or processes may have "local" filters to provide further containment. DOE proposes all of this and triple HEPA filters prior to exhausting. Thus the only projections of

materials to be routinely released are gaseous (largely noble) and these only at levels well below regulatory standards.

IV. Transportation

The history of transportation of spent nuclear fuel (or radioactive materials in general) has been excellent. It is believed that the transportation system could be designed to adequately protect the public from excessive radiation exposure and, if an MRS facility is sited in Tennessee, the overall national population exposure would be less than in a no-MRS system. However, Tennesseans exposure to radiation from the transport of these wastes could increase due to an MRS and the DOE should document any increase or decrease for the State.

The transportation accident scenarios presented do not indicate that the public would be at risk from any radiation released. However, these are the credible accidents or the accidents with a reasonable probability of occurring. We feel that for emergency planning and analysis purposes the worst case accident scenarios should be calculated without regard to probability.

As several independent studies have concluded, the increased radiation exposure to Tennesseans from the transport of this spent fuel to and from an MRS facility under normal conditions would be miniscule and this projected risk from radiation is less than that from the non-radiological transportation risks.

There must be a recognition of the fact that on a technical level one cannot react to a perception of greater risk and promote an alternative that increases actual risk, i.e., it would be patently foolish to take actions to prevent something because of a perceived risk when the alternative had actual risk much greater than the real risk value of the perceived risk. An added complication to this is comparing the hypothetical radiological accident risk from transport of spent nuclear fuel to the real non-radiological accident risk. Fortunately there is enough disparity to facilitate comparison.

V. Occupational and Environmental Safety

This facility design concept has included several features to assure environmental and occupational safety. Some of these features are the shielding design, use of robotics where possible, redundancy in monitoring systems, contamination control programs, protected areas, nuclear criticality safeguards, frequent inventories of the spent fuel on-site, ALARA considerations and the improved planning for decommissioning of this facility. The present NRC licensed casks for shipment of spent fuel have proven their integrity. We believe that storage casks can be designed, constructed, and licensed to insure environmental and public protection from their contents.

Decommissioning cannot be completely addressed at this time. The difficulty and cost of this will depend on the facility's operational history. It is

commendable that the facility design has incorporated easily cleanable surfaces and accessible features in the planning stages.

The question of a criticality accident has not been adequately addressed by the DOE in these documents. We feel that this is a serious omission. What has been calculated in the present design system is basically that a criticality accident is not possible. It is assumed that the likelihood of mistakes or multiple failure accidents that could place material in a critical configuration is so low that it is "not possible." We could not reach that conclusion from data presented. We feel that the possible severity of such an accident warrants emergency and design planning or further analysis should be made to support DOE's original conclusion.

During normal operations and most accidents, except the most severe criticality accidents mentioned above, this facility would not have a significant effect on the environment.

Emergency response planning for on- and off-site accidents should be better documented.

VI. Inspection and Enforcement

The NRC would employ a resident inspector at this facility who should have unrestricted access to all operations. DOE has stated they would also have inspectors onsite to monitor the facility as well as incoming and outgoing shipments of spent fuel. We have been assured by DOE that State inspectors could be allowed onsite provided that appropriate agreements between the State and DOE are made. We feel that such arrangements are necessary and important and should be made to allow State inspectors free access to all operations. This would allow the State to examine working conditions and assure the public as to the operational safety of the facility.

In addition, it is our intention to inspect in conjunction with the Tennessee Public Service Commission all shipments of spent nuclear fuel and radioactive waste into and out of the MRS facility for compliance with all applicable regulations.

VII. Licensing

The construction and operation of this facility would be licensed by the Nuclear Regulatory Commission. The State of Tennessee can not issue a license to authorize the storage of spent fuel at this facility but this Division would want to be involved in all pre-licensing and licensing activities of this facility. Most of the material needed to fully evaluate this proposal would be submitted to the NRC by the DOE in their license application and this information would be very important to the State.

The NWPA in Section 141(a) recognizes Section 202(3) of the Energy Reorganization Act, which requires that NRC license any DOE facilities used primarily for the receipt and storage of high-level waste (HLW) resulting from activities licensed under the Atomic Energy Act. The MRS facility is

designed to package and temporarily store spent nuclear fuel that has been out of a reactor for at least 5 years, to store nonfuel-bearing components resulting from the disassembly and consolidation of fuel assemblies, and to store other waste resulting from this receipt and handling of spent fuel. This facility will be subject to the regulations in 10 CFR 72.

If this facility is approved by Congress and licensed by the NRC, there would be some license conditions needed in order to assure the citizens of DOE's good faith. Some of these conditions are as follows:

- a) a license restriction on the length of time the waste could be stored at the facility;
- b) a license condition restricting the age of the spent fuel that could be accepted at the MRS;
- c) a license restriction on the amount of waste that could be stored at the facility;
- d) a license condition authorizing the specific radioactive wastes and amounts that could be accepted and/or stored at this facility.

The State would also want to be involved in the review of all amendment requests made to the NRC.

DOE's responses to our questions concerning licensing by the NRC indicates a certain naivety with licensing, at least as we practice it.

VIII. Cost Estimates

This Division has also been asked to estimate the annual cost to the State that would be incurred if this facility is authorized by Congress. The majority of this added expense would be from the additional personnel needed to inspect the facility and the shipments of spent nuclear fuel. Additional personnel would be needed in the environmental monitoring and emergency response programs. Another expense would be that incurred in the training of these persons and the additional equipment and supplies that would be needed. These expenses would begin immediately if the MRS is authorized since a significant amount of manpower would be utilized in the pre-licensing and licensing oversight for this facility. After licensing, that manpower would be utilized in operational oversight and emergency planning and training activities.

Below are two estimates of annual cost to the State in 1985 dollars, one utilizing 24 hours-a-day, seven days-a-week man power, and one utilizing eight hours-a-day manpower.

24 hours-a-day

Personnel

1 - Environmental Manager 1 - Management
1 - Environmental Specialist 5 - Training (In-house & local)
1 - Environmental Specialist 4 - Environmental Monitoring
7 - Environmental Specialist 3 - Inspection/Emergency Response/
Environmental Monitoring
1 - Secretary 2
2 - Clerk 2

Salaries

1 - EM 1	\$ 29,892
1 - ES 4	29,892
1 - ES 3	26,196
6 - ES 2	147,168
1 - Sec 2	10,848
2 - Clerk 2	19,632
Total	263,628
+ Benefits 25%	65,907
	<u>\$ 329,535</u>

Other

Travel, Communications, Supplies, Training, Equipment,
\$ 110,000

Grand Total \$ 439,535

8 hours-a-day

Personnel

1 - Environmental Manager 1 - Oversight
1 - Environmental Specialist 5 - Training (In-house and local)
1 - Environmental Specialist 4 - Environmental Monitoring
3 - Environmental Specialist 3 - Inspection/Emergency
Response/Environmental Monitoring
1 - Secretary 2
2 - Clerk 2

Salaries

	\$ 179,532
+ 25% Benefits	44,883
Total	<u>\$ 224,415</u>

Other

Travel, Communications, Supplies, Training, Equipment
\$ 82,000

Grand Total \$ 306,415

IX. Conclusions

Our summary conclusion is that the proposed transport, facility operation, consolidation, etc. can be done safely with little or no undue radiological impact on workers, public, or the environment. This is based as noted on general impressions of material evaluated by individuals familiar with such proposals and operations. If we received such a presentation relative to a facility to be licensed by us we would feel confident they knew what they were doing and that they were on the right track. We would be just as confident in noting that they had a long way to go to become licensed. Many specifics would have to be provided with all of the concerns noted herein answered adequately and much additional detail to be provided.

X. Attachments

Attached are copies of Curricula Vitae, DRH questions, DOE responses to those questions, and a Facility Design Workshop Summary.

Michael H. Mobley

Office:

Division of Radiological Health
Tennessee Department of Health and Environment
TERRA Building - 150 Ninth Avenue, North
Nashville, Tennessee 37219-5404
Phone: (615) 741-7812

Education

1968 - Bachelor of Arts, Major: Physics and Math
1972 - Master of Science, Major: Physics
Minor: Radiation Biology
1983 - Master of Public Administration, Major: Public Administration

Present Position

Director, Division of Radiological Health, Tennessee Department of Health and Environment.

Commissioner representing Tennessee on the Southeast Compact Commission for Low-Level Radioactive Waste Management. Appointed by Governor.

State Liaison to the Nuclear Regulatory Commission. Appointed by Governor.

Experience

17 years with the Tennessee Department of Health and Environment. Most of these years have been spent supervising portions of the Division of Radiological Health with responsibility for management of the entire Division since June of 1982. Developed and implemented Tennessee's regulatory program for particle accelerators. This Division regulates the use of all radiation sources in Tennessee with exception of certain federal facilities.

Served as Chairman of the Nuclear Regulatory Agreement States (25 states) in 1984 and as Chairman of the Southern Emergency Response Council (16 states) for 1982-83. Served on numerous Task Forces for the Conference of Radiation Control Program Directors.

Taught Health Physics classes at the University of Tennessee, Nashville and for the University of Tennessee (Engineering Extension Courses in Nashville) in addition to presenting many specific ad hoc training sessions as necessary for specific causes.

Additional Training and Education

Health Physics, 10-week course at Oak Ridge Associated Universities sponsored by the Atomic Energy Commission.

Industrial Radiography, 1-week course at the University of Alabama sponsored by the Atomic Energy Commission.

Microwave Instrumentation and Survey Technique, 1-week course at the Southeastern Radiological Laboratory sponsored by the Public Health Services, Bureau of Radiological Health.

Medical Uses of Radionuclides, 1-week course at the Baylor College of Medicine sponsored by the Atomic Energy Commission.

Licensing and Regulatory Practices, 3-week course at the Bethesda office of the Atomic Energy Commission.

Sophisticated X-ray Survey Training, 3-day course at the University of Alabama sponsored by the Public Health Services, Bureau of Radiological Health.

Radiation Protection Surveys with Emphasis on Environmental Sampling Around Nuclear Power Plants, 2-week course at the University of Michigan.

Training in Nationwide Evaluation of X-ray Trends standardized procedures and data evaluation methods, 2-day course at Vanderbilt University sponsored by the Public Health Services, Bureau of Radiological Health.

Nuclear Reactor Emergency Response Operations, 1-week course sponsored by the Environmental Protection Agency and the Nuclear Regulatory Commission.

Radiological Emergency Response Operations, 1-week course at the Nevada Test Site sponsored by ERDA and NRC.

Federal Diagnostic X-ray training, 1-week course sponsored by the Public Health Services, Bureau of Radiological Health.

Radiation Accident Assessment, 1-week course at the Emergency Management Institute sponsored by the Federal Emergency Management Institute.

Special Topics in Reactor Health Physics, 1-week course at the University of Kentucky sponsored by the Health Physics Society.

Reactor Theory, Operations, and Emergency Planning, 1-week course sponsored by the Nuclear Regulatory Commission.

Indoor Radon Evaluation and Control, 2-day course sponsored by the Environmental Protection Agency.

Debra G. Shults

Office:

Division of Radiological Health
Tennessee Department of Health and Environment
TERRA Building - 150 Ninth Avenue, North
Nashville, Tennessee 37219-5404
Phone: (615) 741-7812

Education

1980 - Bachelor of Science, Major: Environmental Health

Present Position

Environmental Specialist 3, Division of Radiological Health, Tennessee
Department of Health and Environment

Experience

4 years with the Tennessee Department of Health and Environment. Duties have included inspection of radiation machines, the review of applications and the issuance of radioactive material licenses, review of applications and the issuance of registrations for accelerator facilities, review of Registered Inspector X-ray inspection reports for possible fee reduction, review of qualifications and approval/disapproval of Registered Inspector applicants, special projects for the Division including low-level waste surveys, field team member and/or RMCC coordinator for emergency response at fixed nuclear facilities, upkeep of all licensing information and statistics in the computer system.

Additional Training and Information

Radiological Emergency Response, 10-day course at the Nevada Test Site sponsored by FEMA.

Medical X-ray Protection, 1-week course sponsored by the Food and Drug Administration, Bureau of Radiological Health.

Hazardous Incident Training, 2-day course sponsored by the EPA.

Radioactive Material Transportation Workshop, 1-week course sponsored by the U.S. Department of Energy.

Orientation Practices in Licensing Practices and Procedures, 2-week course at the Bethesda office of the Nuclear Regulatory Commission.

Medical Uses of Radionuclides, 1-week course at Oak Ridge Associated Universities sponsored by the Nuclear Regulatory Commission.

Health Physics and Radiation Protection, 5-week course at Oak Ridge Associated Universities sponsored by the Nuclear Regulatory Commission.

Operation of Nuclear Gauges, 1-day course sponsored by Troxler Electronic Laboratories, Inc.

Reactor Theory and Operations, 1-week course sponsored by the Nuclear Regulatory Commission.

Radiation Protection Engineering, 1-week course sponsored by the Nuclear Regulatory Commission.

Roger L. Halsey

Office:

Division of Radiological Health
Tennessee Department of Health and Environment
TERRA Building - 150 Ninth Avenue, North
Nashville, Tennessee 37219-5404
Phone: (615) 741-7812

Education

1977 - Bachelor of Science, Major: Physics
1986 - expected completion of Master of Science,
Major: Environmental Engineering

Present Position

Environmental Specialist 4, Division of Radiological Health, Tennessee
Department of Health and Environment

Experience

8 years with the Tennessee Department of Health and Environment.
Currently functioning as a technical advisor and planner for emergency
response activities at nuclear power plants and other nuclear incidents.
Duties have included inspection of radiation machines, supervisor of the
environmental monitoring program, technical advisor for all emergency
response activities and has taught radiation protection courses to first-
responders.

Additional Training and Education

Health Physics, 10-week course at Oak Ridge Associated Universities
sponsored by the NRC.

Sealed Source Use in Industrial Radiography, 1-week course sponsored by the
NRC.

Radiological Emergency Response, 10-day course at the Nevada Test Site
sponsored by FEMA.

Radiological Accident Assessment, 1-week course at the Emergency
Management Institute sponsored by FEMA.

Training in Nationwide Evaluation of X-ray Trends standardized procedures
and data evaluation methods, 2-day course at Vanderbilt University sponsored
by the Public Health Services, Bureau of Radiological Health.

Reactor Theory and Operations, 1-week course sponsored by the Nuclear
Regulatory Commission.

Internal Dosimetry, 1-week course at Oak Ridge Associated Universities.

Elizabeth Freyre Gilley

Office:

Division of Radiological Health
Tennessee Department of Health and Environment
Dempster Building, 305 Springdale Avenue
Knoxville, Tennessee 37917
Phone: (615) 673-6035

Education

1979 - Bachelor of Science, Major: Environmental Health

Present Position

Environmental Specialist IV, Division of Radiological Health, Tennessee
Department of Health and Environment

Experience

5 years with the Tennessee Department of Health and Environment. Duties have included inspection of radiation producing machines and radioactive materials licenses, inspection report writing and review, enforcement procedures tracking and issuance of Commissioners Orders. Participated as a radiological response team member and scenario planning committee member for nuclear plant exercises.

Currently functioning as an emergency response planner. Duties include coordinating with the Tennessee Emergency Management Agency and TVA in the training of emergency response team personnel and local responders, development and maintenance of planning documents, and emergency response correspondence. Also participate in special projects for the Division.

Additional Training and Education

Health Physics, 10-week course at Oak Ridge Associated Universities sponsored by the Nuclear Regulatory Commission.

Inspection Procedures, 1-week course sponsored by the NRC.

Radiological Emergency Response, 10-day course at the Nevada Test Site sponsored by FEMA.

Radiological Accident Assessment, 1-week course at the Emergency Management Institute sponsored by FEMA.

Operation of Nuclear Gauges, 1-day course sponsored by Troxler Electronic Laboratories, Inc.

Radiological Monitor Series, Train-the-Trainer Course (Trainer III), 1-week course at the Emergency Management Institute sponsored by FEMA.

DRH
DGS
MHA

October 16, 1985

Mr. Ben Rusche
Office of Civilian Radioactive Waste Management
Office of Policy Integration and Outreach
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Dear Mr. Rusche:

On August 8, 1985, I sent to you a compilation of questions and issues to be considered by the Department of Energy in completing its study of the M.R.S. facility. These were prepared by state Executive Departments' response teams, and/or individual staff members assigned to the state M.R.S. review.

While the D.O.E. has addressed some of these questions, comments, and issues, it has come to my attention that it has neglected those submitted by the Division of Radiological Health. The attached documents include those questions and comments submitted by the Division of Radiological Health on July 10, 1985 and in our letter of August 8, 1985 as well as a few additional issues. I would appreciate if you would forward this material to the appropriate office (or contractor) so that the issues may be addressed, promptly, in writing.

Sincerely,

JAMES E. WORD
Commissioner

JEW/DS/ake

Division of Radiological Health
Tennessee Department of Health and Environment

Comments/Questions related to "MRS Program, Briefing Package, Environmental Assessment: Approach and Outline, OCRWM, June 1985." These questions should not be construed as being all inclusive or exhaustive but should be seen as indication of the areas where it is perceived that documentation is inadequate.

1. Where would low-level waste from the MRS site be disposed? How much will be generated yearly?
2. Does the diagram on page 6 depict the final storage configuration?
3. The document repeatedly refers to a 15,000 MTU maximum storage capacity in its design and facility characteristics. However, it is also mentioned that the capacity could possibly be expanded to 70,000 MTU. How will this expansion be implemented? Why?
4. One of the design objectives is to operate at the rate fuel is accumulating at reactors with a characteristic of the MRS facility being 3,600 MTU in and out. Can the facility ever achieve this objective considering the fuel already stored at the reactor sites? What is the projected daily rate of spent fuel accumulation in five years, in ten years? What is projected date of catch-up?
5. Have the "Preconstruction-Phase Activities" outlined on page 19 of the document been achieved for the three candidate sites?
6. What will be the size of the shipments per rail coming into the MRS facility?
7. Were radiological impacts considered in the "Air/Water Quality Impacts"?
8. If the MRS facility is sited at Hartsville, Tennessee, the second statement on page 34 seems unrealistic.
9. If the total cost for a 1,800 MTU/yr facility is estimated at \$1 billion, will the cost of this facility be estimated at \$2 billion considering 3,600 MTU/yr in and out?
10. It appears that this document evaluates the backup MRS facility instead of the integral MRS facility that DOE is proposing to Congress.
11. What is the DOE perceived state role of ongoing inspection and monitoring of the MRS facility?
12. What exactly are the high-level wastes (HLW), remote-handled transuranic wastes (RHTRU) and contact-handled transuranic wastes (CHTRU) mentioned throughout this document? We want to be informed from the onset of this project unlike the present status DOE facilities in Oak Ridge.
13. Why a 20-year license as opposed to a 5-year renewable license?
14. What is the youngest fuel the MRS will be licensed for? We would expect a license restriction on the age of the fuel.

15. What are the criteria for rejection or acceptance of the incoming waste shipments? Will there be NRC or state inspectors on-site to inspect shipments as they come into the facility?
16. Will the railcars or truck trailers be monitored? By whom?
17. Will State personnel be "unauthorized persons" and denied entry into the facility?
18. What will the security of the facility entail?
19. This document mentions "monitoring systems." Please outline in detail these systems.
20. Will water be used in the facility to cool the fuel assemblies and if so what is the possible contamination to the water supply should engineered barriers break down? Where will this water be stored?
21. What are the 182 sites referred to on page 3.1? Is this related to actual site selection?
22. How much heat will be generated by each cask (or dry well) and how much total heat will be added to the environment by a fully operational MRS facility?
23. What will the radiation level be at the surface of a free standing cask and at the ground surface of a dry well?
24. How much activity will be in the atmosphere of each hot cell during normal operations and how much activity from the hot cells would be released to the environment if the HEPA system failed and how much activity would be released if other engineered barriers break down?
25. Will the facility and the casks in the storage yard (or the dry wells) be designed to withstand the same natural and manmade accidents that nuclear plant design is subject to (tornadoes, floods, earthquakes, plane crashes, etc.)?
26. How much radioactivity would be released if a dry well container or a free standing cask with 5 year old fuel was sheared through all fuel assemblies and 10% of the uranium pellets caught fire?
27. The design-basis accidents do not seem to represent a worse-case analysis for this facility since it is assumed all safety systems will work as planned.
28. In Table 4.4, why isn't 55,000 MWD/MTU considered for 5 year old fuel?
29. Page 4.5, Diesel Fuel Fire: Why is it assumed that only a 1000 Curie release will occur?
30. Where will the wastes from the decommissioning phase of the MRS be stored or disposed of?

31. Why is the dose commitment period for a fuel reprocessing plant different from all the others? (Page 4.8)
32. The EPA annual dose limit of 25 mrem/yr for individuals is for the whole fuel cycle not just the MRS portion.
33. Why should we add this expected radiation dose to a population who is already receiving some estimated exposure from facilities in this proposed site area? This seemed to be a consideration of impact at other sites.
34. What are the radiological impacts of possible accidents during decommissioning of this facility as mentioned on page 4.11?
35. There are discrepancies between Table B.5 of this document and information from the references we have reviewed. These references are: U.S.A.E.C., "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, 1972 and Wolff, T.A., "The Transportation of Nuclear Materials," Sandia National Laboratories, SAN D84-0002, 1984.
36. It is mentioned in the document that there will be radioactive material onsite during the final stages of construction. What are these materials?
37. Will there be a meteorological program such as the nuclear plants have?
38. What will happen to the "transportable metal storage casks"? Will these be decontaminated and used again?

DA/ah/2-20

Division of Radiological Health
Tennessee Department of Health and Environment
Questions related to MRS proposal

1. Will there be a license condition to restrict the length of time the spent fuel may be stored at the MRS?
2. Will there be NRC regulations such that any change in the MRS license would be reviewed at state level prior to approval and issuance just as required for reactor amendments?
3. How often will physical inventories of the spent fuel be performed? Will there be state involvement in these inventories?
4. Will there be outgoing inspections of the dedicated trains? Who will perform these inspections? What criteria will be followed?
5. There should be emergency response planning for a 10 mile radius around the site. What would the state's role be in emergency planning and response at the facility?
6. What type of inspectors will be at the MRS? How many? What will DOE's role be in inspecting the shipments and facility?
7. If there is a fire on-site what will happen to the water from this accident?
8. In the June 1985 MRS Briefing Package submitted to the state by the DOE, one of the tables lists annual atmospheric release rates for four radionuclides: H-3, Co-60, Kr-85 and I-129. Please explain why these four are mentioned specifically.
9. What is the isotopic inventory of one year old, five year old, ten year old, and ten year old with "high burnup" fuel bundles from a PWR? From a BWR?
10. How far apart would the most sensitive fuel rods have to be separated (in the presence of adequate moisture) to become critical?
11. How would the facility handle a criticality accident in the hot cell?
12. What would happen to a storage cask if the fuel became critical? (e.g. Would the pressure burst it open explosively?)
13. What would the source term be from the amount of spent fuel in a storage cask if it went critical?

14. Will the storage casks (in either the field drywell or the concrete above ground configuration) be subject to certain geometries to prevent criticality? (That is, will the casks emit enough neutrons to cause a problem if they were placed close to each other?)
15. In the event that DOE accepts fuel from a reactor that is less than 1 year old, what will be done with the fuel at the MRS?
16. What will be the concentrations and type of isotopes present in the air of the hot cell in the operating MRS? And what is the estimated air flow through the HEPA filters?
17. Will the sealed storage casks, as they produce helium and other noble gases, increase the internal pressure with time? And, if so, how long will it take to exceed design pressures?

DS/ake

Department of Energy

Washington, DC 20585

OCT 23 1985

Mr. James E. Word
Commissioner
State of Tennessee
Department of Health and Environment
Cordell Hull Building
Nashville, TN 37219

Dear Mr. Word:

This package responds to the items contained in the attachments to your letter of August 8, 1985. As indicated in my letter of September 16, 1985, each of the attachments to your letter has been reviewed and marked to indicate the type of response we are able to provide for the issues raised. The first enclosure of this letter explains our use of response codes. The second enclosure is the markup of your letter, and the third enclosure contains our specific answers.

We had also proposed sharing drafts of the "Proposal to Congress" and its supporting documents with you for concurrent review so that this important program could go forward on the schedule we had committed to the Congress. These documents are being prepared and each will be shared in preliminary draft form with you in the near future.

To begin this process I am pleased to provide preliminary drafts of the primary volumes of the Conceptual Design Report that we have received from our Architect Engineer (Enclosure 4). The remaining few volumes will be provided by our Oak Ridge Operations Office shortly along with additional copies of the Conceptual Design Report. We expect that changes will be made to these documents during the review process.

My staff will be working with yours to understand any comments or suggestions as these preliminary drafts are revised into documents suitable for presentation to the Congress on January 15, 1986. We remain very appreciative of your continued cooperation and assistance in this important program.

Sincerely,

Ben C. Rusche, Director
Office of Civilian Radioactive
Waste Management

Enclosures

Response Codes

Enclosures to the August 8, 1985 letter, Commissioner Word to Ben Rusche have been annotated in the margins to indicate the responses we are able to provide to the issues raised. The notes in the margins indicate the following:

<u>Response</u>	<u>Explanation</u>
A-A1	The first character, A, indicates that an answer is included herewith. The second character is the attachment indicator. The third character corresponds to the question number in the attachment.
A-A2	
-	
-	
-	
A-B1	
-	
-	
-	
etc.	
C	The statement provides comment, the commenters position or a suggestion for DOE consideration in developing the MRS proposal to Congress and has been duly noted.
P	Answers will be found in the materials that support the MRS Proposal to Congress. The second part identifies the specific document:
	EA - Environmental Assessment
	CD - Conceptual Design
	PP - Program Plan
I	The answer is indeterminate at this time. Information will be developed later during MRS implementation if approved by Congress.

Enclosure 2

Markup of attachments to August 8 letter from Commissioner
James Word to Ben C. Rusche.

STATE OF TENNESSEE
DEPARTMENT OF HEALTH AND ENVIRONMENT
CORDELL HULL BUILDING
NASHVILLE, TENNESSEE 37219

JAMES E. WORD
COMMISSIONER

August 8, 1985

Mr. Ben Rusche
Office of Civilian Radioactive Waste Management
Office of Policy Integration and Outreach
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, DC 20585

Dear Mr. Rusche:

I am today sending you a preliminary compilation of questions and issues to be considered by the Department of Energy as it completes its study of the need, technical and economic feasibility, design, and environmental consequences of a monitored retrievable storage (MRS) facility in Tennessee.

As you know, the state of Tennessee has voiced the opinion that the scope of the DOE study should be broadened. We believe that Congress, the state of Tennessee and the public should be able both to assess the need for an MRS, and to compare economic and environmental costs of each viable systems alternative considered by the Department of Energy--in one document.

The questions, issues and comments in this package were prepared by state Executive Departments' response teams, and/or individual staff members assigned to the state MRS review. The questions and comments in the package are derived from two sources.

The first set (Attachments A through G) represent direct responses to the Department of Energy's outline for an Environmental Assessment, as presented to state officials on June 12, 1985, and the briefing package distributed at that meeting. Many of these questions were raised verbally to DOE staff and contractors at the follow-up working session on July 10, 1985, in Nashville.

The second set of questions and issues (Attachments H through L) emerged from the five state workshops conducted on July 10, 1985. All questions and comments are reported as submitted by workshop reporters, without editing, in order that the exact concerns of workshop participants might be communicated to DOE. I would appreciate it if you would forward all the material to the appropriate DOE office (or contractor) so that the issues may be addressed without delay. We request that you let us know, in writing, how the Department of Energy plans to respond to the specific issues raised.

100-110

Mr. Ben Rusche
Page 2
August 8, 1985

In addition to the detailed questions listed in the attachments, there appears to be several cross-cutting concerns running through the state's comments. These include continuing uncertainties and inconsistencies in the definition, role and integration of an MRS into a national commercial radioactive waste management system; the compartmentalization of the DOE planning process; the disjunction between the Need and Feasibility Report (with its cost estimates) and the Environmental Assessment; the lack of specific and timely information on facility design, monitoring systems, transportation routes and risks, and estimated costs; and the extremely compressed time-frame for the state to complete its review of final DOE documents before they are submitted to the Congress.

While we feel that each of the attached questions deserves some attention in further MRS development, priority for DOE response should be given to questions which relate to these cross-cutting concerns.

Finally, as a major element of the state's independent assessment of the need and feasibility of MRS, we will prepare a conceptual outline (including a list of the most critical questions to be addressed) of what we consider to be an adequate need and feasibility and environmental impact assessment document. We will forward this conceptual outline to the Department of Energy within a few weeks. The state plans to measure the final DOE documents which are delivered to the Congress against this standard.

Sincerely,

JAMES E. WORD
Commissioner

JEW/rnc

Enclosures (12)

cc: Commissioner Charles A. Howell, III
Commissioner William H. Long
Commissioner William H. Walker, III
Commissioner Robert E. Farris
Mr. Gary T. Myers
Mr. Peter Gross

Division of Radiological Health
Tennessee Department of Health and Environment

Comments/Questions related to "MRS Program, Briefing Package, Environmental Assessment: Approach and Outline, OCRWM, June 1985." These questions should not be construed as being all inclusive or exhaustive but should be seen as indication of the areas where it is perceived that documentation is inadequate.

1. Where would low-level waste from the MRS site be disposed? How much will be generated yearly? A-D1
2. Does the diagram on page 6 depict the final storage configuration? A-D2
3. The document repeatedly refers to a 15,000 MTU maximum storage capacity in its design and facility characteristics. However, it is also mentioned that the capacity could possibly be expanded to 70,000 MTU. How will this expansion be implemented? Why? A-D3
4. One of the design objectives is to operate at the rate fuel is accumulating at reactors with a characteristic of the MRS facility being 3,600 MTU in and out. Can the facility ever achieve this objective considering the fuel already stored at the reactor sites? What is the projected daily rate of spent fuel accumulation in five years, in ten years? What is projected date of catch-up? A-D4
5. Have the "Preconstruction-Phase Activities" outlined on page 19 of the document been achieved for the three candidate sites? A-D5
6. What will be the size of the shipments per rail coming into the MRS facility? A-D6
7. Were radiological impacts considered in the "Air/Water Quality Impacts"? A-D7
(P-EA)
8. If the MRS facility is sited at Hartsville, Tennessee, the second statement on page 34 seems unrealistic. C
9. If the total cost for a 1,800 MTU/yr facility is estimated at \$1 billion, will the cost of this facility be estimated at \$2 billion considering 3,600 MTU/yr in and out? A-D9
10. It appears that this document evaluates the backup MRS facility instead of the integral MRS facility that DOE is proposing to Congress. A-D10
(P-EA)
11. What is the DOE perceived state role of ongoing inspection and monitoring of the MRS facility? A-D11
12. What exactly are the high-level wastes (HLW), remote-handled transuranic wastes (RHTRU) and contact-handled transuranic wastes (CHTRU) mentioned throughout this document? We want to be informed from the onset of this project unlike the present status DOE facilities in Oak Ridge. A-D12
13. Why a 20-year license as opposed to a 5-year renewable license? A-D13
14. What is the youngest fuel the MRS will be licensed for? We would expect a license restriction on the age of the fuel. A-D14

15. What are the criteria for rejection or acceptance of the incoming waste shipments? Will there be NRC or state inspectors on-site to inspect shipments as they come into the facility? A-D15
16. Will the railcars or truck trailers be monitored? By whom? A-D16
17. Will State personnel be "unauthorized persons" and denied entry into the facility? A-D17
18. What will the security of the facility entail? A-D18
19. This document mentions "monitoring systems." Please outline in detail these systems. A-D19
(P-CD)
20. Will water be used in the facility to cool the fuel assemblies and if so what is the possible contamination to the water supply should engineered barriers break down? Where will this water be stored? A-D20
21. What are the 182 sites referred to on page 3.1? Is this related to actual site selection? A-D21
22. How much heat will be generated by each cask (or dry well) and how much total heat will be added to the environment by a fully operational MRS facility? A-D22
(P-EA)
23. What will the radiation level be at the surface of a free standing cask and at the ground surface of a dry well? A-D23
24. How much activity will be in the atmosphere of each hot cell during normal operations and how much activity from the hot cells would be released to the environment if the HEPA system failed and how much activity would be released if other engineered barriers break down? I
A-D24
25. Will the facility and the casks in the storage yard (or the dry wells) be designed to withstand the same natural and manmade accidents that nuclear plant design is subject to (tornadoes, floods, earthquakes, plane crashes, etc.)? A-D25
26. How much radioactivity would be released if a dry well container or a free standing cask with 5 year old fuel was sheared through all fuel assemblies and 10% of the uranium pellets caught fire? A-D26
27. The design-basis accidents do not seem to represent a worse-case analysis for this facility since it is assumed all safety systems will work as planned. A-D27
28. In Table 4.4, why isn't 55,000 MWD/MTU considered for 5 year old fuel? A-D28
29. Page 4.5, Diesel Fuel Fire: Why is it assumed that only a 1000 Curie release will occur? A-D29
30. Where will the wastes from the decommissioning phase of the MRS be stored or disposed of? A-D30

31. Why is the dose commitment period for a fuel reprocessing plant different from all the others? (Page 4.8) A-D31
32. The EPA annual dose limit of 25 mrem/yr for individuals is for the whole fuel cycle not just the MRS portion. A-D32
33. Why should we add this expected radiation dose to a population who is already receiving some estimated exposure from facilities in this proposed site area? This seemed to be a consideration of impact at other sites. A-D33
34. What are the radiological impacts of possible accidents during decommissioning of this facility as mentioned on page 4.11? (P-PP)
(P-ER) A-D34
35. There are discrepancies between Table B.5 of this document and information from the references we have reviewed. These references are: U.S.A.E.C., "Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants," WASH-1238, 1972 and Wolff, T.A., "The Transportation of Nuclear Materials," Sandia National Laboratories, SAND84-0002, 1984. C
A-D35
36. It is mentioned in the document that there will be radioactive material onsite during the final stages of construction. What are these materials? A-D36
37. Will there be a meteorological program such as the nuclear plants have? A-D37
38. What will happen to the "transportable metal storage casks"? Will these be decontaminated and used again? A-D38

Facility Design Workshop Report

This workshop held on 7/10/85 was chaired by Mike Mobley, DRH, TDHE. A list of attendees is attached.

Peter Gross, DOE MRS OR, discussed the general concept of the facility design. He emphasized the need for flexibility in the design so that it could adapt to changing needs and/or technology. Discussions were held on several specifics, e.g., depth of protection provided by design, specifics on air handling/filtering, monitoring of storage casks, availability of technology for operation, etc.

SEE
COMMENTARY

The only planned effluent from the plant is air which will be filtered via numerous mechanisms to ensure no radiological impact on the environment. One area of concern was whether adequate attention had been given non-radiological air impact, e.g., air emission from the concrete cask fabrication facility.

Conclusions reached by the group were:

1. This group will not do a specific design review. Agencies represented by the individuals in the group may have the authority and will do design specific reviews at the appropriate time.
2. A technical meeting should be scheduled to discuss more specific information on the conceptual design.
3. A facility for state personnel, i.e., Public Service personnel and Division of Radiological Health personnel, should be included in the design. This facility should include space and provisions, e.g., communications equipment for use as a transportation emergency operations for spent fuel shipment accidents.
4. A field trip to visit similar facilities in Idaho, Nevada, and Oak Ridge will be arranged.
5. The Department of Energy will provide the group with the following:
 - A. The Functional Design Criteria Document will be furnished to the group. This is a controlled document with numbered copies with set procedures for changes. Copies of changes provided for all controlled copies.
 - B. The Executive Summary Document will be provided when finalized in October.
 - C. The Regulatory Assessment Document will be provided when finalized in October.
 - D. The Environmental Assessment Document will be provided when finalized in December.

Submitted 7/22/85 by MHM

MHM/ah/1-40

Attachment

MHM 7/22/85

Facility Design

Mike Mobley
Heather Whitlow
Nick Fielder
Hap Macintire
Michael W. Walker
W. Dave Woods
Bobby Langford
Bill Carter
Peter Gross

TDHE--Division of Radiological Health
TDHE--Air Pollution Control
Conservation--Archaeology Division
TDHE--Water Supply
City of Oak Ridge--Staff
Ralph M. Parsons Co.
Tenn. P.S.C.
Tenn. P.S.C.
DOE, Oak Ridge MRS office

MHM/ah/1-40

Attachment D Responses

- A-D1 Decisions on specific operating procedures for the MRS have yet to be made so the disposition of low level waste (LLW) has not been determined. Likely options are disposal in commercial facilities where the activity level of the waste permits economic disposal or disposal in the repository. It is generally assumed for purposes of these analyses that disposal will be in the repository.

LLW will be treated to remove water and also to reduce volume by compaction where practical. Metallic wastes will be sealed in 55 gallon drums. Combustibles, resins and sludges from waste treatment systems will be mixed with cement and placed in 55 gallon drums. It is estimated that about 500 drums per year of LLW will be produced at the MRS.

- A-D2 The diagram showing the multiple barriers between the waste and the biosphere represents the current preferred configuration for field storage at the MRS. Most waste entering the MRS would be prepared for shipment to the repository and dispatched to this facility promptly. If this were not feasible, as could be the case during initial MRS operation when the repository was not yet operational or when the operating repository was temporarily unable to receive waste, storage within the MRS receiving and handling facility would be utilized. Waste would be diverted to field storage only after these alternatives were exhausted.

- A-D3 The MRS Proposal to Congress will recommend a limit of 15,000 MTU of MRS storage. The candidate site identification process included a size criterion to accommodate system expansion and occurred before DOE had considered limiting MRS capacity. The 70,000 MTU represents the design capacity of the first repository. If the Congress authorizes an MRS for no more than 15,000 MTU and the repository is deferred so that this is inadequate to meet system needs, alternatives will need to be addressed. Among these alternatives could be expansion of MRS, but this is recognized to be a sensitive issue which we expect will be fully addressed in the MRS proposal and subsequent Congressional reaction.

- A-D4 The Mission Plan Waste Acceptance schedules for the improved performance system (with an integral MRS) shows that it is 2003 before reactor discharges exceed 3,000 MTU per year and 2006 before more than 3,600 MTU are discharged in a year.

Projected annual reactor discharges in five years (1990) are 2,150 MTU (6 per day) and in ten years (1995) are 2,500 MTU (7 per day).

The acceptance schedule just cited shows that, if fuel is accepted strictly according to date of discharge, all fuel over 10 years out of reactors will have been accepted by 2011. This occurs because a second repository (not currently authorized) is assumed to come on stream in 2006 and the minimum aging requirement is set at ten years.

- A-D5 Baseline monitoring and field investigations were performed previously for these areas. These studies will be updated for the specific sites as needed during licensing activities.
- A-D6 Based on the assumptions that 70 percent of nuclear powerplants ship spent fuel to the MRS facility by rail and that 100 ton gross loaded weight rail shipping casks with a cask capacity of 10 metric tons are used to transport the spent fuel, the frequency of rail cask shipments into the MRS facility is projected to be about 280 per year. The number of trains coming into the MRS will be somewhat less than this number, depending upon the number of rail casks shipped per train.
- A-D7 Radiological impacts on air are discussed in PNL 5476, Section 4.1 (included in the June 12, 1985 briefing package). Water is not used in the process cells and is used rather sparingly in other decontamination activities. It is collected and either evaporated or treated and reused. No measurable releases are expected via water effluents. These issues are also treated in the Environmental Assessment to be included in the package submitted to Congress along with the MRS Proposal.
- A-D9 The facility is estimated to cost approximately \$800 - \$1,000 million, in 1985 dollars. Capital and operating costs for 15,000 MTU of licensed storage over a 26 year period are expected to total approximately \$2.7 billion if all 15,000 MTU of storage is deployed.
- A-D10 Yes, PNL-5476 addresses an 1,800 MTU per year backup MRS. The EA to be included with the MRS Proposal to Congress will address the site specific 3,600 MTU/year integral MRS designs.
- A-D11 Section 117(c) of the NWPA addresses the consultation and cooperation (C&C) process, and the written agreement that would be executed between DOE and the State. Section 117 (c)(8) states provisions "by which such State may conduct reasonable independent monitoring and testing of activities on the...site, except that such monitoring and testing shall not unreasonably interfere with or delay onsite activities." This section of the NWPA would be applicable to an authorized MRS. It is DOE's intent to fully address this provision, so that an appropriate monitoring role for the State is provided for in the written C&C agreement.

A-D12 The primary high level waste form to be received by the MRS is spent nuclear fuel (SNF). The plant capacity is specified in these terms (MTU), and the process cells are designed for efficient handling of this form. They are also capable of handling small quantities of other wastes including remote and contact handled transuranic waste (TRU) and solidified high level waste (HLW).

TRU is waste contaminated with high atomic weight alpha emitting isotopes of half-life greater than 20 years and an abundance of more than 100 nanocuries (10^{-9}) per gram of waste. Section 141 of the NWPA requires that the proposal for an MRS be for the purpose of authorizing the receipt and storage of high level nuclear waste and spent nuclear fuel. No TRU waste meets the current definition of either HLW or SNF. NRC is authorized by section 2 (12) of the NWPA to determine, by rule, the radioactive wastes that require permanent isolation and are not within the current definition of HLW. Should NRC engage in such rulemaking in the future, it is possible that some wastes currently classified as TRU would be reclassified as HLW and therefore eligible for handling in the MRS as well as a repository. We are, of course, unable to predict at this time what those wastes might be.

The equivalent of 650 MTU of HLW will be produced by the solidification and vitrification of reprocessing residuals currently at the West Valley New York site. These "glass logs" (approximately 2' diameter, 10' long) will be enclosed in steel canisters. There are no plans to ship this waste to the MRS but the temporary storage and overpacking at the MRS prior to disposal are options that could be considered.

The President has decided that defense HLW will be emplaced in the repository along with commercial waste. There are no plans, nor have any advantages been identified, for handling defense waste at the MRS. It may be of benefit to the waste program to combine shipments of defense and commercial wastes in dedicated trains at a marshalling yard but this option has not been studied.

A-D13 NRC regulations currently allow licensing of independent spent fuel storage facilities for 20 years and for subsequent renewal. If an integral MRS is authorized and built to serve only the first repository, it will need to operate at least through 2021 according to the waste acceptance schedule for the improved performance system in the Mission Plan. This requires the MRS to operate a minimum of 26 years from the proposed start date. It would be an unnecessary expense to seek a shorter license with frequent renewals.

A-D14 The NRC regulates public and occupational radiological health and safety through standards that are not specific to operating parameters such as the age of the fuel to be handled in the MRS. The waste system generally is designed around spent fuel that has been aged ten years. It would be well into the second decade of MRS operation before fuel with only ten years aging were received if age were the only determinant of the acceptance sequencing. However, the standard contracts with utilities allow exchanging of positions in the queue and also for emergency deliveries. Further, these contracts specify a minimum aging time of five years. Spent fuel deliveries during the early operations of an MRS would be expected to be well in excess of ten years out of reactor.

A-D15 The Standard Contract for Disposal of Spent Nuclear Fuel and/or High Level Waste between DOE and the owners or generators of such fuel or waste (10 CFR Part 961) sets forth requirements pertaining to the condition of the spent fuel prior to acceptance by DOE. (As provided in the contract, DOE will accept title to and responsibility for the spent fuel at the nuclear powerplant after it has been packaged in a shipping cask.) The contractual provisions that relate to the condition of the spent fuel are paraphrased below:

Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste, 10CFR961.11.

Article IV

- A.2.b. requires a complete description of the fuel being delivered (as set forth in Appendix F).
- B.1. requires DOE to accept all SNF of domestic origin generated by the utility without regard to condition.
- B.2.a. requires DOE to provide loading and handling procedures and specifications for failed fuel canisters.

Article VI

- A.1.b. requires the utility to accurately classify spent fuel as specified in Appendix E.
- A.2.a. requires utility to provide a detailed description of the spent fuel being delivered (as set forth in Appendix F) and to notify DOE of changes as soon as they become known.
- A.2.b. requires utility to obtain confirmation from DOE prior to delivery of non-standard fuel.

- B.2. authorizes DOE verification during cask loading.
- B.3.a. DOE may refuse to accept improperly described fuel until corrections made.

Appendix E

- A.1. requires reasonable effort by utility to properly classify spent fuel:
 - a. standard fuel
 - b. non-standard fuel (5 categories)
 - c. failed fuel (3 categories)
- B.6.a. requires visual inspection for evidence of structural deformity or damage necessitating special handling, (failed fuel class F-1)
- B.6.b. previously encapsulated assemblies, (class F-3)
- B.6.c. specifies packaging compliance with regulatory requirements.

Additionally, radiological surveys of the shipping cask and truck trailer or railcar combination will be performed by DOE both prior to departure from the nuclear powerplant and upon arrival at the MRS facility, at a minimum. NRC inspectors will likely audit the DOE-performed radiological surveys but are not expected to routinely perform radiological surveys themselves. If the State asks to perform inspections of the arriving and departing spent fuel shipments, DOE will accommodate the State by providing an on-site inspection station for such purposes.

- A-D16 From a radiological standpoint, DOE will perform a radiological survey of all spent fuel shipments prior to departure from nuclear powerplants and upon arrival at the MRS facility, at a minimum. From a nonradiological standpoint, the progress of shipments of spent fuel will be monitored by DOE at a minimum by means of two-way radio communication with the truck or train carrying the shipment.
- A-D17 We intend to fully comply with all applicable State and local requirements, consistent with DOE's responsibilities under the NWPA. In this regard, we are amenable to agreements that would ensure State personnel ready access to the MRS facility to observe operations, to review of health and safety records for the facility and to perform any other agreed to functions. Also, DOE has already agreed to provide an on-site inspection station for State personnel to inspect spent fuel shipments entering and exiting the MRS facility.

A-D18

Security features in the MRS design provide for protection and control of access to the site to avoid sabotage of the facility, theft of material for release or threat of release and theft of special nuclear material. The entire developed area is to be fenced with three-strand barbed wire. The limited access area is to be enclosed in an 8' steel wire fabric fence topped with multistrand barbed wire. The protected area will have a second, similar fence with a 100' wide alarm zone between the fences. Other security features are protective lighting, 24 hour closed circuit TV surveillance of the barriers and a patrol road for periodic patrol and alarm response. Access to the protected areas are to be by manned security gates equipped with detectors for explosives, metal and radiation. Doors to critical areas are to be alarmed and locked.

A-D19 Monitoring related to security is described above (A-D18). A-D37 below deals with meteorological monitoring. In addition, there are extensive systems for monitoring the process and all remote cells and work stations in the Receiving and Handling (R&H) Building as well as in the service buildings. The block diagram (Drawing H-3-56786) shows these systems that feed into the R&H control room. Note that there is a redundant, backup monitoring and control system in a control room of the site services building.

A-D20 The MRS design specifically excludes water contact with the spent nuclear fuel for either cooling or decontamination.

A-D21 The 182 sites referred to on page 3.1 of the environmental document were sites identified by a literature search of environmental assessments, environmental impact statements, reports and open literature to represent the different physical conditions found throughout the 48 contiguous states. From among these 182 sites, 21 were found to provide sufficient information to represent the three reference site types (arid, warm-wet, cold-wet) which were to be analyzed in the environmental document.

The environmental document was used as the basis for the Department's conclusion that different climate types need not be a controlling factor in locating sites for the proposed MRS.

A-D22 Spent nuclear fuel irradiated to 28,000 to 33,000 MWD/MTU and 10 years out of reactor generates about one kilowatt of heat per MTU. A canister of this consolidated fuel would generate from 1260 to 1650 watts. A drywell would hold one canister. A storage cask would hold 12 canisters for a heat load of 15 to 20 kilowatts (kw). The heat generated from the operating MRS is provided in the EA.

A-D23 Assuming spent fuel at a burn-up of 33,000 MWD/MTU and 10 years out of reactor, the dose rate at the side surface of the free standing storage cask is projected to be 6 millirem per hour. The dose rate at ground level for a dry storage well is projected to be 3 millirem per hour. For five year old fuel, the dose rates are projected to be 14 millirem per hour and 6 millirem per hour, respectively.

A-D24 There is insufficient experience with dry consolidation of spent fuel to provide a definitive response to this question. However, some estimates can be made based on the data in Section 4.1.2 and Table 4.1 of PNL 5476, which are also estimates.

The amount of scale on spent fuel assemblies will vary greatly as will the particle size of material dislodged during laser cutting if, indeed, laser cutting is used. Thus the amount of airborne activity in an operating cell at one time is highly conjectural at this time, although a planned extensive development and demonstration program will provide this data prior to final selection of consolidation equipment. The environmental document, PNL 5476, assumes an annual release of 6.7×10^4 Ci of cobalt (the primary contaminant in the cell) for an 1,800 MTU per year facility with two cells. It also provides a conservative estimate of the efficiency of three series configured HEPA filters, each with 99.97% efficiency, to be such that 10^{-4} of the particles are released. The throughput of a cell would not be affected by going from a 2 cell 1,800 MTU per year facility to a 4 cell 3,600 MTU facility. Therefore, a cell would release about 3.4×10^4 Ci/yr. At a 10^4 decontamination factor, the cell must see 3.4 Ci in a year. Assuming that 0.1% of this is airborne at any point in time, the cell atmosphere must contain around 0.0034 Ci.

The probability of the simultaneous failure of all three HEPA filters is extremely small. If this simultaneous failure occurred it would be reasonable to estimate that about half of the cell airborne activity, or around 0.002 Ci, might be released before corrective action could be taken. If only one, or even two, of the filters failed the release would be substantially less.

A-D25 Although the risks associated with the MRS facility and field storage are substantially less than those for a nuclear powerplant, the regulatory requirements for designs that will withstand natural and manmade accidents are essentially the same.

A-D26 Releases from damaged fuel assemblies are given in PNL 5476. The canister shearing accident for the field

drywell is considered, but without fuel burning postulated by this question. Releases are limited to a fraction of volatile fission products. The fuel is already in an oxidized state and burning of 10% of the pellets is beyond the design event classes identified in analyzing credible accidents. Further, shearing of a sealed concrete storage cask (the cask wall consists of 3 feet of reinforced concrete and 2 inches of steel) is well beyond any design basis accident considered.

Current designs of canisters for consolidated fuel would accommodate three PWR fuel assemblies. A field drywell would contain one canister and a sealed storage cask, 12 canisters. Each PWR fuel assembly irradiated to 33,000 MWD/MTU and aged 5 years would contain about 275,000 curies of fission product and actinides.

- A-D27 The design basis accidents were postulated to result in credible worst-case impacts. Such design basis accidents can often result from mechanical failures, natural disasters or operator error rather than a failure of safety systems.
- A-D28 Data for spent fuel with 55,000 MWD/MTU exposure and 5 years aging is available but is not useful in analyzing the waste system that is being designed. Fuel of this description would require special handling because it is outside the current design criteria established for shipping, handling and disposal facilities.
- A-D29 Shipping casks must be designed to survive a 30 minute, 1475 F fire and other sequential tests without permitting releases above 1,000 curies of Kr. Such fires at an MRS site would be very unlikely and, with the surveillance systems to be used at an operating MRS, the severity and length of burn would be held below that specified by the applicable Department of Transportation regulations. With the shipping cask designed to keep releases low and a very low probability that these design parameters could be exceeded at the MRS site, the use of the maximum permitted release in accident analyses is a very conservative assumption and use of a higher value seems unwarranted.
- A-D30 Following completion of operations and removal of all spent fuel and high level waste to the repository, MRS facilities and equipment would be decontaminated. The wastes from this decontamination and any materials or equipment that could not be reduced to residual levels acceptable for unrestricted use under NRC regulations would be disposed of to commercial low level waste facilities or the repository.

- A-D31 The dose commitment periods quoted in Table 4.9 on page 4.8 of the draft environmental document are taken from different studies. The study of fuel reprocessing plant impacts contained in the final EIS on the Management of Commercially Generated Radioactive Waste used 70 years to bound lifetime population exposure. For example: an individual who begins work at 18 years of age, works approximately 50 years, then retires, might live about 70 years.
- A-D32 The Department is aware that the annual dose limit of 25 mrem/yr for individuals is for the whole fuel cycle and the statement of their dose limit on page 4.8 of the draft environmental document was not intended to indicate otherwise.
- A-D33 The expected additional dose to the public of the generic MRS facility described in the environmental document is approximately 0.007 mrem/year. The impact of this additional dose is expected to be minimal.
- A-D34 The impacts of decommissioning an MRS facility will be covered in the MRS Program Plan and in the MRS Environmental Assessment. Since all spent fuel and high-level waste will be shipped to the repository prior to decommissioning the MRS, very little radiological impact is expected during decommissioning.
- A-D35 We appreciate your notation that there are discrepancies between the information in Table B.5 of the draft environmental document and the sources you cited. We will look further into this information.
- A-D36 It is possible that there would be some overlap of construction activities in the MRS supporting facilities or the storage field and the initial receipt of spent fuel by the receiving and handling facility.
- A-D37 Yes, there would be a meteorological program for measuring radionuclides in MRS effluents as there is for nuclear power plants. NRC regulations 10CFR50, Appendix A covering operating reactors and 10CFR72.74 covering independent spent fuel storage installations both require means for measuring radionuclide releases during normal operation and under accident conditions. In addition, DOE will comply with any monitoring requirements which may be established by EPA under section 112 of the Clean Air Act.
- A-D38 "Transportable metal storage casks", i.e., casks which are suitable for both storing spent fuel at an MRS facility and shipping spent fuel (with the addition of overpacks and impact limiters as required to license the cask for transport), is a concept which was evaluated during the early stages of planning an MRS facility but not selected

for further design development. The MRS facility is being designed to utilize two distinct types of casks: shipping casks and storage casks. Shipping casks would be used solely for transporting spent fuel from nuclear powerplants to an MRS facility and from the MRS facility to a geologic repository. Shipping casks would be decontaminated, as necessary, to ensure the safe transport of spent fuel. The storage casks would be used to store spent fuel at the MRS facility, as necessary. The storage casks would never leave the MRS facility during its operational period. Upon decommissioning, all storage casks would be decontaminated. By virtue of being able to handle and use shipping casks, the MRS would also be able to handle and use transportable storage casks.

It may be that some utilities will procure transportable storage of spent fuel at reactor sites. DOE has tentatively agreed to accept title to spent fuel stored in such casks to and to ship the fuel in such casks to the MRS facility if it is authorized and built. Whether such casks will be reused is unclear at this time. Since the casks will be the property of the utilities, it will be for them to decide regarding decontamination and reuse.

Attachment G

No response required.

Attachment H

Proceedings of the July 12 workshop on the role of the MRS including feedback and concerns of the group were provided by Dan Shilstat of the Tennessee Department of Conservation. This record is useful to DOE in focusing on State concerns. It is believed that the issues raised were substantially resolved or explained.

Attachment I

Ruth Neff provided a record of the July 12 workshop on MRS site selection. The report is structured to enumerate the issues of concern, record the discussion that dealt with them and list the future actions needed. This input is greatly appreciated.

Attachment J

Mike Mobley, Tennessee Department of Health and Environmental provided a resume of the proceedings of the July 10 Workshop on MRS facility design. Areas of discussion and conclusions were recorded. This input is appreciated.

Attachment K

A-K1 The Department understands the concern of the Tennessee Department of Transportation with respect to emergency response capabilities. Assessments of the cost of communication and other emergency response equipment, and training will be addressed in negotiations with the State if Congress approves the MRS facility.

Attachment L

The Office of the Attorney General for Tennessee gave the State's position on DOE/State interactions under the NWPA. These matters are in litigation and it is inappropriate to respond.

Conceptual Design Report Notes:

1. There are frequent references to 15,000 MT field cask storage 100 MT HLW, 1,000 MT lag storage, in cell storage, rail and truck casks awaiting unloading, etc. These are capacity figures and do not imply that all will be filled to capacity with waste. We expect the onsite inventory of waste to be held below 15,000 MTU.
2. The design report may imply that site selection and other decisions have been made. These are to be considered design assumptions. The actual decisions depend upon Congressional Action and State interactions.
3. Note that a number of design changes have not been fully implemented in this report (see Volume I, Book II, pp iii, iv).
4. References to "spent fuel processing" refer to mechanical operations not chemical reprocessing as was done at West Valley.
5. Cost estimates are for comparison of site/concept combinations. Additional cost reviews are in progress.
6. The remaining volumes of the Conceptual Design Report (CDR) are under preparation and will be available later in October and in November through the Oak Ridge Operations Office.
7. In addition to the reports provided herewith, ten sets are being provided to the Oak Ridge Operations Office (contact Peter Gross) for use by the State of Tennessee.

Department of Energy
Washington, DC 20585

NOV 13 1985

DK

RECEIVED BY

NOV 14 1985

Mr. James E. Word
Commissioner
State of Tennessee
Department of Health and Environment
Cordell Hull Building
Nashville, TN 37219

SAFE GROWTH TEAM

Dear Mr. Word:

Your letter to Mr. Rusche of October 16, 1985 inquired about our responses to questions from the Tennessee Division of Radiological Health (DRH) relating to the proposed MRS facility and presented additional questions from that agency. Responses to the initial set of DRH questions were transmitted with the letter to you from Mr. Rusche on October 23, 1985, which also included responses to questions and comments from other State agencies as well as a number of volumes of the MRS Conceptual Design Report. Responses to the second set of DRH questions are provided in enclosure 1.

Continuing our program of sharing with you preliminary segments of the MRS Proposal package to Congress, I have also included, as enclosure 2, additional sections of the MRS Conceptual Design Report that have become available since the previous package was sent on October 23, 1985. I will continue to forward preliminary sections of the Proposal package as they reach the appropriate state of maturity to provide you and your staff as much review time as possible.

Sincerely,

J. Roger Hilley
Associate Director for
Storage and Transportation Systems
Office of Civilian Radioactive
Waste Management

Enclosures

Enclosure 1

Responses to "Additional Issues" raised by DRH and submitted to Ben Rusche by letter from Commissioner Word dated October 16, 1985.

1. Q: Will there be a license condition to restrict the length of time the spent fuel may be stored at the MRS?

A: NRC regulations (10 CFR 72) provide for licensing independent spent fuel storage facilities for not to exceed 20 years but with provisions for renewal. There are no specific regulatory limits on the length of time spent fuel may be stored at a licensed storage facility.

2. Q: Will there be NRC regulations such that any change in the MRS license would be reviewed at state level prior to approval and issuance just as required for reactor amendments?

A: NRC regulations specify the publication of a Federal Register notice of proposed action, or of a hearing 30 days in advance, to consider license amendments unless the Commission determines that the proposed amendment does not involve a significant hazard consideration or an unreviewed safety question. A hearing would be held only if an affected party requests it. DOE would expect to maintain liaison with State and local officials on such matters regardless of regulatory requirements.

3. Q: How often will physical inventories of the spent fuel be performed? Will there be state involvement in these inventories?

A: NRC regulations require a physical inventory of special nuclear materials held by licensees a minimum of once each 12 months. MRS nuclear material control and accounting would be based on state-of-the-art techniques and current regulations. State involvement in these activities can be arranged by mutual agreement.

4. Q: Will there be outgoing inspections of the dedicated trains? Who will perform these inspections? What criteria will be followed?

A: A radiological survey and an equipment safety survey would be performed on all spent fuel shipments leaving the MRS facility by DOE personnel or by a DOE contractor. If the State of Tennessee wished to conduct its own inspections of spent fuel shipments leaving the MRS facility, DOE would accommodate the State inspectors.

The criteria for both the radiological and equipment safety surveys would be developed in detail as the spent fuel shipment picture (e.g. cask designs, rail car designs, make-up of dedicated trains, etc.) becomes clearer. DOE would at a minimum require each shipment to meet or exceed NRC's and DOT's radiological criteria for dedicated use shipping casks and DOT's equipment safety requirements for dedicated train shipments.

5. Q: There should be emergency response planning for a 10 mile radius around the site. What would the state's role be in emergency planning and response at the facility?

A: Emergency response planning for the State, as well as affected local governments, would be included in the consultation and cooperation (C&C) process that is required by Section 117(b) and (c) of the NWPA for authorized MRS sites. Section 117(c)(5) specifically addresses emergency preparedness and response. The role the State and local governments would have in these activities would be worked out with DOE, and specifically included in the written C&C agreement that would be executed between DOE and the State. The appropriate emergency response radius would be determined later based on the final facility design and the potential hazard to the surrounding area.

6. Q: What type of inspectors will be at the MRS? How many? What will DOE's role be in inspecting the shipments and facility?

A: To construct and operate an MRS facility, DOE must seek and obtain a license from the NRC under the provisions of Title 10, Part 72 of the code of Federal Regulations. These provisions include the requirement that NRC will assign a full-time resident inspector onsite at the MRS facility. The provisions further specify the DOE will afford unfettered access to the facility to any other NRC inspectors duly authorized by NRC to inspect the MRS facility.

All inspectors other than NRC inspectors are expected to be DOE or contractor personnel. The total number of inspectors and their assignments would be decided as part of the MRS facility and transportation system final design.

DOE accepts full responsibility for the safe and efficient transportation, possible storage, and final disposal of high level radioactive waste. DOE will establish its own

inspection program utilizing its own or contractor personnel to ensure that this is accomplished. DOE would accommodate the needs of non-DOE personnel that are duly authorized by other authorities to conduct inspections of the MRS facility and/or shipments to and from the MRS facility in cases where the authorizing authority has jurisdiction or DOE finds that such inspections would be constructive and would not disrupt MRS facility operations. In addition DOE anticipates that a local safety oversight group will be involved in inspections of this type.

7. Q: If there is a fire on-site what will happen to the water from this accident?

A: Design study 26, provided herewith in Enclosure 2, deals with fire protection issues. Water is not used in the highly contaminated shielded hot cells. Water run-off from fire systems is designed to flow from uncontaminated areas to potentially contaminated areas as is the case for air flow. The run-off water flowing into radioactive drains is processed normally in the low level waste system. Contaminated fire water run-off should not find its way into process or sanitary sewer drains. However, effluents from these systems are to be monitored and alarmed so that corrective action can be taken to avoid unplanned radioactive discharges.

8. Q: In the June 1985 MRS Briefing Package submitted to the state by the DOE, one of the tables lists annual atmospheric release rates for four radionuclides: H-3, Co-60, Kr-85, I-129. Please explain why these four are mentioned specifically.

A: Three of the four radionuclides listed in the environmental report (PNL 5476) are gases and, if released into the hot cell, would not be captured by the HEPA filters. The fourth radionuclide, ^{60}Co , is an activation product present in fuel assembly structural materials and in scale deposits. While not a gas, it could be present in the cell atmosphere as an aerosol generated during removal of fuel assembly end pieces and consolidation activities. As explained in the response to question 24 of the first set of DRH questions provided on October 23, the HEPA filters capture almost all of these particles. Further, the authors of PNL 5476 indicated that analyses subsequent to publication of this environmental report show that significantly less ^{60}Co will be released than the 6.7×10^{-9} Ci/year reported for an 1800 MTU per year

facility. Except for ^{60}Co , the radionuclides comprising the source term are bound up in a solid matrix as fuel pellets. Only a portion of the gaseous constituents can escape through a breach in the fuel cladding. Other radionuclides remain fixed in the pellet matrix. Consequently, only the four radionuclides listed are candidates to become airborne and be capable of release.

9. Q: What is the isotopic inventory of one year old, five year old, ten year old, and ten year old with "high burnup" fuel bundles from a PWR? From a BWR?

A: Attached are tables of the isotopic content of spent fuel calculated by the Origen code for fuel at current target burnup levels. Also attached are BWR tables for a lower irradiation level to show the effect of burnup on isotope inventory. Tables for "high burnup" are not readily available and have been omitted to avoid delaying the response.

Also attached is a table of spent fuel inventory by burnup as a function of time. Note that there is very little fuel that could be called "high burnup". Discharge exposures are expected to continue to rise but it will be many years before important quantities of "high burnup" fuel are likely to show up at a waste receiving facility.

10. Q: How far apart would the most sensitive fuel rods have to be separated (in the presence of adequate moisture) to become critical?

A: The fuel assemblies are designed with the most reactive fuel rod arrangement, thus the intact fuel assemblies will be more reactive than the consolidated fuel rods. The spent reactor fuel is less reactive than fuel with low or no burnup. The most reactive amount of moisture is about 10% by volume. In all cases, a single fuel assembly cannot go critical by itself regardless of burnup or moisture. The MRS is designed so that more than two independent failures are needed before a criticality is possible.

11. Q: How would the facility handle a criticality accident in the hot cell?

A: The MRS Facility is designed to prevent accidental criticality. For example, there is no moderator present in the hot cells during normal operation. All spent fuel

must be removed before the hot cells can be decontaminated. Spool pieces must be installed to introduce the decontamination (decon) liquid. The lag storage pits have curbs around them to keep decon liquid out and the decon liquid is used in batch amounts with the quantity in each batch being insufficient to fill the lag storage pits to the level of the bottom of the stored fuel.

If a criticality is postulated in spite of these preventive measures, the hot cell walls are thick enough to attenuate the radiation and reduce personnel exposure to acceptable levels. The ventilation system will remove any particulates that would be released. The release of noble gases and volatile gaseous compounds through the stack should be comparable to the release of the noble gas burden in one fuel assembly. This has been calculated as about 0.1 mrem for the total integrated dose at the MRS site boundary.

12. Q: What would happen to a storage cask if the fuel became critical? (e.g. Would the pressure burst it open explosively?)

A: The consolidated fuel rods or intact fuel assembly is placed in a stainless canister with no moderator present. The canister is filled with inert gas and is welded shut and the weld is tested to ensure a gas-tight seal. The canister is then placed in the cask, again with no water present, and a thick steel lid is welded to the steel cask liner, again providing a gas-tight seal.

The chance of any moisture entering the cask is vanishingly small. However, a criticality analysis of the loaded cask has shown that it will be safely subcritical for any amount of water present.

13. Q: What would the source term be from the amount of spent fuel in a storage cask if it went critical?

A: No source term determination has been made for a storage cask criticality scenario because a criticality accident in this cask is not credible.

14. Q: Will the storage casks (in either the field drywell or the concrete above ground configuration) be subject to certain geometries to prevent criticality? (That is, will the cask emit enough neutrons to cause a problem if they were placed close to each other?)

A: The concrete cask walls are three feet thick and effectively decouple the cask contents from any outside influences. Thus neutronic considerations do not impose any constraints on cask placement. The drywells are spaced far enough apart to be neutronically isolated from one another.

15. Q: In the event that DOE accepts fuel from a reactor that is less than 1 year old, what will be done with the fuel at the MRS?

A: There are no plans to accept fuel at the MRS that is cooled less than one year. NRC regulations specify aging of at least one year. The Standard Contract with utilities specifies five years as the minimum cooling time. The MRS designs are based on fuel irradiated to 33,000 Mwd/T and ten years out of reactor, except that up to 10% of fuel received may be aged five years or aged ten years and irradiated to 55,000 Mwd/T.

Design question

16. Q: What will be the concentrations and type of isotopes present in the air of the hot cell in the operating MRS? And what is the estimated air flow through the HEPA filters?

A: The response to question 24 of the first set of DRH questions forwarded to Commissioner Word on October 23 estimated the particulates that might be present in an operating hot cell. (Note that response 8 of this set of questions indicates that the October 23 response overestimates the particulates). There could also be some fission gases present intermittently if any fuel rods fail during consolidation work. PNL 5476 estimates that one fuel rod for each three PWR assemblies or eleven BWR assemblies could fail and that 10% of the ^3H and ^{129}I and 30% of the ^{85}Kr could be released. All of these gases would pass through the HEPA filters. The release from each rod failure is calculated to be $0.05\text{Ci } ^3\text{H}$, $5 \times 10^{-6} \text{ Ci } ^{129}\text{I}$ and $2.4\text{Ci } ^{85}\text{Kr}$.

The air flow through each shielded process cell is 12,000 cubic feet per minute resulting in a change of air in about ten minutes.

17. Q: Will the sealed storage casks, as they produce helium and other noble gases, increase the internal pressure with the time? And, if so, how long will it take to exceed design pressures?

A: The fission gases and any gaseous decay products are normally contained within the fuel rod cladding (zirconium alloy, 0.0225 inches thick). The fuel is designed with adequate space to accommodate these gases without clad failure. Should the clad fail for any reason, these fission gases would mix with the inert atmosphere of the canister (steel, 0.25 inches thick). Canister failure would be required for these gases to mix with the sealed storage cask atmosphere (steel, 2 inches thick). We do not expect any of these vessels to be affected by a buildup of gas pressure in the spent fuel.

PWR 33000 MWd/T

ITEM 9

FISSION PRODUCTS		PWR-CYCLIC OPERATION-33,000MWd/T/HR		AVERAGE POWER (MW)		1.70230E+01	
NUCLIDE LISTING		1ST SPENT FUEL DECAY UP TO 10 YRS		AVERAGE FLUX (N/CM ² -2-SEC)		3.81510E+13	
RADIOACTIVITY - CURIES		BASIS - ONE FUEL ASSEMBLY		TOTAL BURNUP (MWd)		1.50854E+04	
NUCLIDE	INPUT	INITIAL	1.0 Y	2.0 Y	3.0 Y	4.0 Y	5.0 Y
DE 79	0.0	2.629E-02	2.455E-02	2.349E-02	2.270E-02	2.098E-02	1.983E-02
DE 81	0.0	1.068E-01	1.048E-01	1.038E-01	1.028E-01	1.018E-01	1.008E-01
DE 83	0.0	1.077E-06	1.077E-06	1.077E-06	1.077E-06	1.077E-06	1.077E-06
DE 85	0.0	5.069E-03	4.754E-03	4.554E-03	4.377E-03	4.216E-03	4.071E-03
DE 86	0.0	4.022E-02	3.101E-02	2.468E-02	2.033E-02	1.692E-02	1.419E-02
DE 87	0.0	1.111E-03	1.111E-03	1.111E-03	1.111E-03	1.111E-03	1.111E-03
DE 89	0.0	4.647E-03	3.572E-03	2.745E-03	2.110E-03	1.621E-03	1.244E-03
DE 90	0.0	3.835E-04	3.781E-04	3.699E-04	3.602E-04	3.492E-04	3.368E-04
DE 91	0.0	4.062E-04	3.742E-04	3.470E-04	3.241E-04	3.048E-04	2.886E-04
DE 92	0.0	5.154E-03	7.950E-03	1.070E-02	1.374E-02	1.653E-02	1.908E-02
DE 93	0.0	1.403E-03	1.404E-03	1.404E-03	1.404E-03	1.404E-03	1.404E-03
DE 94	0.0	7.212E-03	1.111E-02	2.187E-02	4.637E-02	1.391E-01	2.914E-01
DE 95	0.0	1.121E-01	1.007E-01	2.455E-01	5.066E-01	3.643E-01	4.187E-01
DE 96	0.0	6.902E-03	3.780E-03	2.877E-03	2.277E-03	1.788E-03	1.394E-03
DE 97	0.0	8.864E-03	1.070E-02	4.082E-02	8.429E-02	1.744E-01	3.701E-01
DE 98	0.0	6.571E-03	6.034E-03	6.034E-03	6.034E-03	6.034E-03	6.034E-03
DE 99	0.0	6.849E-03	1.451E-03	1.913E-03	1.988E-03	1.944E-03	1.893E-03
DE 100	0.0	2.234E-03	1.125E-03	5.644E-04	2.852E-04	1.431E-04	7.251E-05
DE 101	0.0	6.850E-03	1.464E-03	1.915E-03	2.201E-03	2.350E-03	2.498E-03
DE 102	0.0	3.391E-03	1.123E-03	1.644E-03	1.530E-03	1.341E-03	1.141E-03
DE 103	0.0	4.741E-03	4.741E-03	4.741E-03	4.741E-03	4.741E-03	4.741E-03
DE 104	0.0	3.121E-03	1.501E-03	1.787E-03	1.934E-03	1.984E-03	1.972E-03
DE 105	0.0	1.501E-03	1.501E-03	1.501E-03	1.501E-03	1.501E-03	1.501E-03
DE 106	0.0	1.501E-03	1.501E-03	1.501E-03	1.501E-03	1.501E-03	1.501E-03
DE 107	0.0	6.394E-04	6.394E-04	6.394E-04	6.394E-04	6.394E-04	6.394E-04
DE 108	0.0	1.709E-03	4.677E-03	2.371E-02	6.602E-02	3.172E-01	1.121E-01
DE 109	0.0	2.355E-03	4.507E-03	8.103E-03	1.412E-02	2.441E-02	4.154E-02
DE 110	0.0	6.969E-03	5.133E-03	2.938E-03	1.682E-03	9.623E-04	5.309E-04
DE 111	0.0	1.331E-03	1.331E-03	1.331E-03	1.331E-03	1.331E-03	1.331E-03
DE 112	0.0	6.534E-03	2.237E-03	1.758E-03	1.471E-03	1.257E-03	1.082E-03
DE 113	0.0	5.241E-03	2.142E-03	1.289E-03	7.544E-04	4.664E-04	2.807E-04
DE 114	0.0	3.689E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 115	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 116	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 117	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 118	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 119	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 120	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 121	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 122	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 123	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 124	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 125	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 126	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 127	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 128	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 129	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 130	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 131	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 132	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 133	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 134	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 135	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04
DE 136	0.0	3.602E-03	1.819E-03	1.173E-03	7.031E-04	4.170E-04	2.470E-04

FISSION PRODUCTS		PWR-CYCLIC OPERATION-33,000MWd/T/HR		AVERAGE POWER (MW)		1.70230E+01	
NUCLIDE LISTING		1ST SPENT FUEL DECAY UP TO 10 YRS		AVERAGE FLUX (N/CM ² -2-SEC)		3.81510E+13	
RADIOACTIVITY - CURIES		BASIS - ONE FUEL ASSEMBLY		TOTAL BURNUP (MWd)		1.50854E+04	
NUCLIDE	INPUT	INITIAL	1.0 Y	2.0 Y	3.0 Y	4.0 Y	5.0 Y
BA136m	0.0	5.104E-04	4.988E-04	4.874E-04	4.764E-04	4.655E-04	4.549E-04
BA137m	0.0	4.879E-03	1.695E-03	3.885E-04	2.044E-02	7.097E-02	2.465E-02
BA140	0.0	8.540E-03	2.180E-03	1.461E-03	1.381E-03	3.491E-03	6.820E-03
CE141	0.0	8.828E-03	2.485E-03	6.284E-04	1.589E-03	4.018E-03	1.018E-03
CE142	0.0	7.816E-03	3.280E-03	1.369E-03	5.713E-03	2.364E-03	9.950E-03
CE143	0.0	1.310E-03	1.310E-03	1.310E-03	1.310E-03	1.310E-03	1.310E-03
CE144	0.0	5.376E-03	2.275E-03	9.352E-04	3.931E-04	1.573E-04	6.377E-04
CE145	0.0	7.243E-03	6.436E-03	5.125E-03	4.088E-03	3.255E-03	2.666E-03
CE146	0.0	5.600E-03	2.273E-03	9.352E-04	3.931E-04	1.573E-04	6.377E-04
CE147	0.0	6.452E-03	2.728E-03	1.120E-03	4.598E-03	1.887E-03	7.498E-03
CE148	0.0	5.492E-03	4.703E-03	7.200E-03	7.404E-03	7.488E-03	7.536E-03
CE149	0.0	3.454E-03	3.410E-03	3.379E-03	3.340E-03	3.301E-03	3.263E-03
CE150	0.0	1.680E-04	1.024E-04	6.245E-05	3.607E-05	2.321E-05	1.415E-05
CE151	0.0	4.698E-04	3.915E-04	3.086E-04	2.508E-04	1.772E-04	1.361E-04
CE152	0.0	2.144E-04	1.025E-04	6.244E-05	3.606E-05	2.322E-05	1.415E-05
CE153	0.0	5.112E-03	6.017E-03	1.023E-03	1.194E-03	1.328E-03	1.428E-03
CE154	0.0	2.871E-03	2.871E-03	2.871E-03	2.871E-03	2.871E-03	2.871E-03
CE155	0.0	3.955E-03	3.955E-03	3.955E-03	3.955E-03	3.955E-03	3.955E-03
CE156	0.0	3.680E-03	3.680E-03	3.680E-03	3.680E-03	3.680E-03	3.680E-03
CE157	0.0	5.499E-03	5.074E-03	4.679E-03	4.317E-03	3.962E-03	3.624E-03
CE158	0.0	1.644E-03	1.008E-03	6.722E-04	7.549E-04	8.894E-04	1.035E-03
CE159	0.0	1.642E-03	6.642E-03	3.878E-03	2.733E-03	1.732E-03	1.035E-03
CE160	0.0	1.632E-03	1.718E-03	1.777E-03	1.822E-03	1.868E-03	1.914E-03
CE161	0.0	1.609E-03	4.921E-03	1.719E-03	6.006E-03	2.098E-03	7.331E-03
CE162	0.0	6.315E-03	1.904E-03	7.741E-04	1.731E-03	2.795E-03	4.741E-03
CE163	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE164	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE165	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE166	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE167	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE168	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE169	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE170	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE171	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE172	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE173	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE174	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE175	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE176	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE177	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE178	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE179	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE180	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE181	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE182	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE183	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE184	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE185	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE186	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE187	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04
CE188	0.0	3.250E-04	3.249E-04	3.247E-04	3.245E-04	3.243E-04	3.239E-04</

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..... N 08														
ACTINIDES		PURE CYCLIC OPERATION-33,000RPM/WHEN											AVERAGE POWER (MW)	1,702,302-01
NUCLEIDE LISTINGS		1ST SPENT FUEL DECAT UP TO 10 TRS											AVERAGE FLUX (CMO-2-SEC)	3,815,10E-13
RADIOACTIVITY - CURIES		BASIS = ONE FUEL ASSEMBLY											TOTAL BURNUP (MWD)	1,50E54E-04
NUCLEIDE	INPUT	INITIAL	1.0 V	2.0 V	3.0 V	4.0 V	5.0 V	6.0 V	7.0 V	8.0 V	9.0 V	10.0 V		
PU238	O.	1.764E-01	1.392E-01	1.090E-01	8.545E-02	6.700E-02	5.253E-02	4.199E-02	3.230E-02	2.533E-02	1.966E-02	1.557E-02		
PU239	O.	1.354E-01	1.408E-01	1.471E-01	1.403E-01	1.393E-01	1.387E-01	1.372E-01	1.351E-01	1.350E-01	1.340E-01	1.330E-01		
PU240	O.	1.485E-02	1.513E-02	1.513E-02	1.513E-02	1.513E-02	1.513E-02	1.513E-02	1.513E-02	1.513E-02	1.513E-02	1.513E-02		
PU240	C.	2.214E-02	2.215E-02	2.216E-02	2.217E-02	2.218E-02	2.219E-02	2.220E-02	2.221E-02	2.222E-02	2.222E-02	2.223E-02		
PU241	O.	5.025E-04	4.792E-04	4.670E-04	4.556E-04	4.564E-04	4.563E-04	4.579E-04	4.604E-04	4.637E-04	4.278E-04	3.126E-04		
PU242	O.	6.661E-01	6.661E-01	6.661E-01	6.661E-01	6.661E-01	6.661E-01	6.661E-01	6.661E-01	6.661E-01	6.661E-01	6.661E-01		
PU243	O.	2.022E-05	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07		
AM241	O.	3.767E-01	1.163E-02	1.910E-02	2.621E-02	3.397E-02	3.961E-02	4.554E-02	5.137E-02	5.692E-02	6.230E-02	6.722E-02		
AM242	O.	3.696E-04	4.255E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04		
AM242M	O.	4.275E-04	4.255E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04	4.256E-04		
AM243	O.	9.116E-09	9.130E-09	9.129E-09	9.129E-09	9.127E-09	9.126E-09	9.126E-09	9.126E-09	9.126E-09	9.126E-09	9.126E-09		
AM245	O.	3.479E-08	1.549E-08	8.918E-08	5.089E-08	3.579E-08	2.619E-08	1.991E-08	1.251E-08	8.258E-09	4.843E-09	1.103E-09		
CM242	O.	1.662E-04	3.586E-03	7.615E-02	1.638E-02	3.737E-02	6.081E-02	1.014E-01	1.579E-01	1.945E-01	1.512E-01	1.480E-01		
CM243	O.	1.368E-01	1.798E-01	1.740E-01	1.722E-01	1.716E-01	1.699E-01	1.689E-01	1.679E-01	1.669E-01	1.659E-01	1.649E-01		
CM244	O.	1.285E-03	1.237E-03	1.190E-03	1.146E-03	1.103E-03	1.061E-03	1.021E-03	9.829E-04	9.460E-04	9.105E-04	8.763E-04		
CM245	O.	1.866E-01	1.866E-01	1.866E-01	1.866E-01	1.866E-01	1.866E-01	1.866E-01	1.866E-01	1.866E-01	1.866E-01	1.866E-01		
CM246	O.	3.870E-02	1.864E-02	3.819E-02	3.819E-02	3.819E-02	3.819E-02	3.817E-02	3.816E-02	3.816E-02	3.815E-02	3.815E-02		
CM247	O.	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07	1.670E-07		
CM248	O.	4.807E-07	4.808E-07	4.808E-07	4.807E-07	4.807E-07	4.807E-07	4.807E-07	4.807E-07	4.807E-07	4.807E-07	4.807E-07		
BU249	O.	2.307E-03	1.033E-03	4.611E-04	2.059E-04	9.193E-04	4.105E-03	1.813E-03	8.184E-04	3.694E-04	1.632E-04	7.205E-05		
CM249	O.	6.194E-07	3.735E-06	5.122E-06	5.735E-06	6.002E-06	6.114E-06	6.157E-06	6.170E-06	6.169E-06	6.167E-06	6.152E-06		
CM250	O.	2.605E-05	2.695E-05	2.176E-05	2.064E-05	1.958E-05	1.854E-05	1.761E-05	1.678E-05	1.584E-05	1.502E-05	1.424E-05		
CM251	O.	1.791E-07	1.799E-07	1.786E-07	1.786E-07	1.785E-07	1.784E-07	1.782E-07	1.780E-07	1.778E-07	1.777E-07	1.776E-07		
CM252	O.	3.303E-04	2.603E-04	2.003E-04	1.542E-04	1.186E-04	9.129E-04	7.025E-04	5.404E-04	4.160E-04	3.201E-04	2.664E-04		
CM253	O.	5.263E-06	2.180E-12	1.647E-18	9.836E-25	6.595E-31	4.622E-37	2.865E-43	1.868E-49	1.333E-55	8.536E-62	5.199E-68		
CM254	O.	9.170E-10	1.307E-11	2.120E-13	3.240E-15	4.027E-17	6.132E-19	1.159E-19	1.842E-20	1.397E-19	1.080E-18	8.353E-20		
CM255	O.	2.170E-06	6.364E-11	5.387E-16	2.79E-21	1.366E-26	6.825E-32	3.409E-37	1.703E-42	8.506E-48	4.249E-53	2.122E-58		

TOTAL 9.640E+01 2.251E+02 5.467E+04 6.966E+04 6.696E+04 6.483E+04 6.289E+04 6.105E+04 3.931E+04 3.764E+04 3.606E+04 3.456E+04

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POSITION PRODUCTY		GE STD BURN 6-6 CYCLE-7.66 M/W WITH										AVERAGE POWER (MW)		AVERAGE FLUX (N/CM ² -2-SEC)		
NUCLIDE LISTING		1ST SPENT FUEL DECAY UP TO 10 YRS										TOTAL BURNUP (MWD)		5.421084-13		
RADIOACTIVITY - CURIES		BASED ON ONE FUEL ASSEMBLY														
		1.0 Y	2.0 Y	3.0 Y	4.0 Y	5.0 Y	6.0 Y	7.0 Y	8.0 Y	9.0 Y	10.0 Y					
CL137	IMPLY	1.789E-04	1.746E-04	1.702E-04	1.667E-04	1.631E-04	1.594E-04	1.556E-04	1.522E-04	1.488E-04	1.454E-04	1.421E-04				
CL138	O.	1.303E-03	1.263E-03	1.223E-03	1.183E-03	1.143E-03	1.103E-03	1.063E-03	1.023E-03	9.83E-04	9.43E-04	9.03E-04				
CL139	O.	1.694E-04	1.654E-04	1.614E-04	1.574E-04	1.534E-04	1.494E-04	1.454E-04	1.414E-04	1.374E-04	1.334E-04	1.294E-04				
CL140	O.	2.232E-03	2.192E-03	2.152E-03	2.112E-03	2.072E-03	2.032E-03	1.992E-03	1.952E-03	1.912E-03	1.872E-03	1.832E-03				
CL141	O.	2.303E-03	2.263E-03	2.223E-03	2.183E-03	2.143E-03	2.103E-03	2.063E-03	2.023E-03	1.983E-03	1.943E-03	1.903E-03				
CL142	O.	1.690E-04	1.650E-04	1.610E-04	1.570E-04	1.530E-04	1.490E-04	1.450E-04	1.410E-04	1.370E-04	1.330E-04	1.290E-04				
CL143	O.	4.397E-04	4.357E-04	4.317E-04	4.277E-04	4.237E-04	4.197E-04	4.157E-04	4.117E-04	4.077E-04	4.037E-04	3.997E-04				
CL144	O.	1.639E-03	1.599E-03	1.559E-03	1.519E-03	1.479E-03	1.439E-03	1.399E-03	1.359E-03	1.319E-03	1.279E-03	1.239E-03				
CL145	O.	1.879E-03	1.839E-03	1.799E-03	1.759E-03	1.719E-03	1.679E-03	1.639E-03	1.599E-03	1.559E-03	1.519E-03	1.479E-03				
CL146	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL147	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL148	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL149	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL150	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL151	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL152	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL153	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL154	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL155	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL156	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL157	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL158	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL159	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL160	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL161	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL162	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL163	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL164	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL165	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL166	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL167	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL168	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL169	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL170	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL171	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL172	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL173	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL174	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL175	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL176	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL177	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL178	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL179	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL180	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL181	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL182	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL183	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL184	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL185	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL186	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL187	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL188	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL189	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL190	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL191	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL192	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL193	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL194	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL195	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL196	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL197	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL198	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL199	O.	1.739E-03	1.699E-03	1.659E-03	1.619E-03	1.579E-03	1.539E-03	1.499E-03	1.459E-03	1.419E-03	1.379E-03	1.339E-03				
CL200	O.	1.631E-03	1.591E-03	1.551E-03	1.511E-03	1.471E-03	1.431E-03	1.391E-03	1.351E-03	1.311E-03	1.271E-03	1.231E-03				
CL201	O.	1.739E-														

ITEM 9

[illegible]

BWR 24600 MWd/T

ITEM 9

Fission Products		GE STD BWR 8-3 CYCLE-2.66 B/F		AVERAGE POWER (MW)								
Radioactivity - Carriers		TEST SPENT FUEL DECAY UP TO 10 YRS		AVERAGE FLUX (N/CM ² -2-SEC)								
		BASED ONE FUEL ASSEMBLY		TOTAL BURNUP (MWd)								
				5.45333E+00								
				5.34077E+13								
				4.49900E+03								
ISOTOPE	INPUT	INITIAL	1.0 Y	2.0 Y	3.0 Y	4.0 Y	5.0 Y	6.0 Y	7.0 Y	8.0 Y	9.0 Y	10.0 Y
CS137	0.0	1.7964E-01	7.3699E-01	0.9434E-01	0.3844E-01	0.2232E-01	0.1672E-01	0.1254E-01	0.9754E-01	0.9472E-01	0.9091E-01	0.8784E-01
CS138	0.0	0.4764E-02	3.4777E-02	0.4764E-02	0.1764E-02	0.1072E-02	0.7672E-03	0.5764E-03	0.4764E-03	0.4764E-03	0.4764E-03	0.4764E-03
CS139	0.0	0.7671E-02	2.7671E-02	0.7671E-02	0.2767E-02	0.1671E-02	0.1071E-02	0.7671E-03	0.7671E-03	0.7671E-03	0.7671E-03	0.7671E-03
CS140	0.0	0.4444E-01	1.4444E-01	0.4444E-01	0.1444E-01	0.0844E-01	0.5444E-02	0.3444E-02	0.2444E-02	0.1444E-02	0.0444E-02	0.0444E-02
CS141	0.0	0.1981E-01	1.0981E-01	0.1981E-01	0.0981E-01	0.0581E-01	0.3981E-02	0.2481E-02	0.1981E-02	0.1481E-02	0.0981E-02	0.0481E-02
CS142	0.0	0.1444E-01	0.6444E-01	0.1444E-01	0.0444E-01	0.0244E-01	0.1444E-02	0.0844E-02	0.0444E-02	0.0244E-02	0.0144E-02	0.0044E-02
CS143	0.0	0.1222E-01	0.6222E-01	0.1222E-01	0.0222E-01	0.0122E-01	0.0722E-02	0.0422E-02	0.0222E-02	0.0122E-02	0.0022E-02	0.0022E-02
CS144	0.0	0.1433E-01	0.6433E-01	0.1433E-01	0.0433E-01	0.0233E-01	0.1433E-02	0.0833E-02	0.0433E-02	0.0233E-02	0.0133E-02	0.0033E-02
CS145	0.0	0.1651E-01	0.6651E-01	0.1651E-01	0.0651E-01	0.0351E-01	0.1651E-02	0.1051E-02	0.0651E-02	0.0351E-02	0.0151E-02	0.0051E-02
CS146	0.0	0.1871E-01	0.6871E-01	0.1871E-01	0.0871E-01	0.0471E-01	0.1871E-02	0.1271E-02	0.0871E-02	0.0471E-02	0.0271E-02	0.0071E-02
CS147	0.0	0.2101E-01	0.7101E-01	0.2101E-01	0.1101E-01	0.0601E-01	0.2101E-02	0.1501E-02	0.1101E-02	0.0701E-02	0.0301E-02	0.0101E-02
CS148	0.0	0.2321E-01	0.7321E-01	0.2321E-01	0.1321E-01	0.0821E-01	0.2321E-02	0.1721E-02	0.1321E-02	0.0921E-02	0.0521E-02	0.0121E-02
CS149	0.0	0.2541E-01	0.7541E-01	0.2541E-01	0.1541E-01	0.1041E-01	0.2541E-02	0.1941E-02	0.1541E-02	0.1141E-02	0.0741E-02	0.0241E-02
CS150	0.0	0.2761E-01	0.7761E-01	0.2761E-01	0.1761E-01	0.1241E-01	0.2761E-02	0.2161E-02	0.1761E-02	0.1361E-02	0.0961E-02	0.0361E-02
CS151	0.0	0.2981E-01	0.7981E-01	0.2981E-01	0.1981E-01	0.1441E-01	0.2981E-02	0.2381E-02	0.1981E-02	0.1581E-02	0.1181E-02	0.0581E-02
CS152	0.0	0.3201E-01	0.8201E-01	0.3201E-01	0.2201E-01	0.1641E-01	0.3201E-02	0.2601E-02	0.2201E-02	0.1801E-02	0.1401E-02	0.0801E-02
CS153	0.0	0.3421E-01	0.8421E-01	0.3421E-01	0.2421E-01	0.1841E-01	0.3421E-02	0.2821E-02	0.2421E-02	0.2021E-02	0.1621E-02	0.1021E-02
CS154	0.0	0.3641E-01	0.8641E-01	0.3641E-01	0.2641E-01	0.2041E-01	0.3641E-02	0.3041E-02	0.2641E-02	0.2241E-02	0.1841E-02	0.1241E-02
CS155	0.0	0.3861E-01	0.8861E-01	0.3861E-01	0.2861E-01	0.2241E-01	0.3861E-02	0.3261E-02	0.2861E-02	0.2461E-02	0.2061E-02	0.1461E-02
CS156	0.0	0.4081E-01	0.9081E-01	0.4081E-01	0.3081E-01	0.2441E-01	0.4081E-02	0.3481E-02	0.3081E-02	0.2681E-02	0.2281E-02	0.1681E-02
CS157	0.0	0.4301E-01	0.9301E-01	0.4301E-01	0.3301E-01	0.2641E-01	0.4301E-02	0.3741E-02	0.3301E-02	0.2901E-02	0.2501E-02	0.1901E-02
CS158	0.0	0.4521E-01	0.9521E-01	0.4521E-01	0.3521E-01	0.2841E-01	0.4521E-02	0.3941E-02	0.3521E-02	0.3121E-02	0.2721E-02	0.2121E-02
CS159	0.0	0.4741E-01	0.9741E-01	0.4741E-01	0.3741E-01	0.3041E-01	0.4741E-02	0.4141E-02	0.3741E-02	0.3341E-02	0.2941E-02	0.2341E-02
CS160	0.0	0.4961E-01	0.9961E-01	0.4961E-01	0.3961E-01	0.3241E-01	0.4961E-02	0.4341E-02	0.3961E-02	0.3561E-02	0.3161E-02	0.2561E-02
CS161	0.0	0.5181E-01	1.0181E-01	0.5181E-01	0.4181E-01	0.3441E-01	0.5181E-02	0.4541E-02	0.4181E-02	0.3781E-02	0.3381E-02	0.2781E-02
CS162	0.0	0.5401E-01	1.0401E-01	0.5401E-01	0.4401E-01	0.3641E-01	0.5401E-02	0.4741E-02	0.4401E-02	0.4041E-02	0.3641E-02	0.3041E-02
CS163	0.0	0.5621E-01	1.0621E-01	0.5621E-01	0.4621E-01	0.3841E-01	0.5621E-02	0.4941E-02	0.4621E-02	0.4221E-02	0.3821E-02	0.3221E-02
CS164	0.0	0.5841E-01	1.0841E-01	0.5841E-01	0.4841E-01	0.4041E-01	0.5841E-02	0.5141E-02	0.4841E-02	0.4421E-02	0.4021E-02	0.3421E-02
CS165	0.0	0.6061E-01	1.1061E-01	0.6061E-01	0.5061E-01	0.4241E-01	0.6061E-02	0.5341E-02	0.5061E-02	0.4641E-02	0.4241E-02	0.3641E-02
CS166	0.0	0.6281E-01	1.1281E-01	0.6281E-01	0.5281E-01	0.4441E-01	0.6281E-02	0.5541E-02	0.5281E-02	0.4881E-02	0.4481E-02	0.3881E-02
CS167	0.0	0.6501E-01	1.1501E-01	0.6501E-01	0.5501E-01	0.4641E-01	0.6501E-02	0.5741E-02	0.5501E-02	0.5141E-02	0.4741E-02	0.4141E-02
CS168	0.0	0.6721E-01	1.1721E-01	0.6721E-01	0.5721E-01	0.4841E-01	0.6721E-02	0.5941E-02	0.5721E-02	0.5321E-02	0.4921E-02	0.4321E-02
CS169	0.0	0.6941E-01	1.1941E-01	0.6941E-01	0.5941E-01	0.5041E-01	0.6941E-02	0.6141E-02	0.5941E-02	0.5521E-02	0.5121E-02	0.4521E-02
CS170	0.0	0.7161E-01	1.2161E-01	0.7161E-01	0.6161E-01	0.5241E-01	0.7161E-02	0.6341E-02	0.6161E-02	0.5741E-02	0.5341E-02	0.4741E-02
CS171	0.0	0.7381E-01	1.2381E-01	0.7381E-01	0.6381E-01	0.5441E-01	0.7381E-02	0.6541E-02	0.6381E-02	0.5981E-02	0.5581E-02	0.4981E-02
CS172	0.0	0.7601E-01	1.2601E-01	0.7601E-01	0.6601E-01	0.5641E-01	0.7601E-02	0.6741E-02	0.6601E-02	0.6241E-02	0.5841E-02	0.5241E-02
CS173	0.0	0.7821E-01	1.2821E-01	0.7821E-01	0.6821E-01	0.5841E-01	0.7821E-02	0.6941E-02	0.6821E-02	0.6421E-02	0.6021E-02	0.5421E-02
CS174	0.0	0.8041E-01	1.3041E-01	0.8041E-01	0.7041E-01	0.6041E-01	0.8041E-02	0.7141E-02	0.7041E-02	0.6621E-02	0.6221E-02	0.5621E-02
CS175	0.0	0.8261E-01	1.3261E-01	0.8261E-01	0.7261E-01	0.6241E-01	0.8261E-02	0.7341E-02	0.7261E-02	0.6841E-02	0.6441E-02	0.5841E-02
CS176	0.0	0.8481E-01	1.3481E-01	0.8481E-01	0.7481E-01	0.6441E-01	0.8481E-02	0.7541E-02	0.7481E-02	0.7041E-02	0.6641E-02	0.6041E-02
CS177	0.0	0.8701E-01	1.3701E-01	0.8701E-01	0.7701E-01	0.6641E-01	0.8701E-02	0.7741E-02	0.7701E-02	0.7241E-02	0.6841E-02	0.6241E-02
CS178	0.0	0.8921E-01	1.3921E-01	0.8921E-01	0.7921E-01	0.6841E-01	0.8921E-02	0.7941E-02	0.7921E-02	0.7441E-02	0.7041E-02	0.6441E-02
CS179	0.0	0.9141E-01	1.4141E-01	0.9141E-01	0.8141E-01	0.7041E-01	0.9141E-02	0.8141E-02	0.8141E-02	0.7641E-02	0.7241E-02	0.6641E-02
CS180	0.0	0.9361E-01	1.4361E-01	0.9361E-01	0.8361E-01	0.7241E-01	0.9361E-02	0.8361E-02	0.8361E-02	0.7861E-02	0.7461E-02	0.6861E-02
CS181	0.0	0.9581E-01	1.4581E-01	0.9581E-01	0.8581E-01	0.7441E-01	0.9581E-02	0.8581E-02	0.8581E-02	0.8081E-02	0.7681E-02	0.7081E-02
CS182	0.0	0.9801E-01	1.4801E-01	0.9801E-01	0.8801E-01	0.7641E-01	0.9801E-02	0.8801E-02	0.8801E-02	0.8281E-02	0.7881E-02	0.7281E-02
CS183	0.0	1.0021E-01	1.5021E-01	1.0021E-01	0.9021E-01	0.7841E-01	1.0021E-02	0.9021E-02	0.9021E-02	0.8421E-02	0.8021E-02	0.7421E-02
CS184	0.0	1.0241E-01	1.5241E-01	1.0241E-01	0.9241E-01	0.8041E-01	1.0241E-02	0.9241E-02	0.9241E-02	0.8641E-02	0.8241E-02	0.7641E-02
CS185	0.0	1.0461E-01	1.5461E-01	1.0461E-01	0.9461E-01	0.8241E-01	1.0461E-02	0.9461E-02	0.9461E-02	0.8841E-02	0.8441E-02	0.7841E-02
CS186	0.0	1.0681E-01	1.5681E-01	1.0681E-01	0.9681E-01	0.8441E-01	1.0681E-02	0.9681E-02	0.9681E-02	0.9041E-02	0.8641E-02	0.8041E-02
CS187	0.0	1.0901E-01	1.5901E-01	1.0901E-01	0.9901E-01	0.8641E-01	1.0901E-02	0.9901E-02	0.9901E-02	0.9241E-02	0.8841E-02	0.8241E-02
CS188	0.0	1.1121E-01	1.6121E-01	1.1121E-01	1.0121E-01	0.8841E-01	1.1121E-02	1.0121E-02	1.0121E-02	0.9441E-02	0.9041E-02	0.8441E-02
CS189	0.0	1.1341E-01	1.6341E-01	1.1341E-01	1.0341E-01	0.9041E-01	1.1341E-02	1.0341E-02	1.0341E-02	0.9641E-02	0.9241E-02	0.8641E-02
CS190	0.0	1.1561E-01	1.6561E-01	1.1561E-01	1.0561E-01	0.9241E-01	1.1561E-02	1.0561E-02	1.0561E-02	0.9841E-02	0.9441E-02	0.8841E-02
CS191	0.0	1.1781E-01	1.6781E-01	1.1781E-01	1.0781E-01	0.9441E-01	1.1781E-02	1.0781E-02	1.0781E-02	1.0041E-02	0.9641E-02	0.9041E-02
CS192	0.0	1.2001E-01	1.7001E-01	1.2001E-01	1.1001E-01	0.9641E-01	1.2001E-02	1.1001E-02	1.1001E-02	1.0241E-02	0.9841E-02	0.9241E-02
CS193	0.0	1.2221E-01	1.7221E-01	1.2221E-01	1.1221E-01	0.9841E-01	1.2221E-02	1.1221E-02	1.1221E-02	1.0441E-02	1.0041E-02	0.9441E-02
CS194	0.0	1.2441E-01	1.7441E-01	1.2441E-01	1.1441E-01	1.0041E-01	1.2441E-02	1.1441E-02	1.1441E-02	1.0641E-02	1.0241E-02	0.9641E-02
CS195	0.0	1.2661E-01	1.7661E-01	1.2661E-01	1.1661E-01	1.0241E-01	1.2661E-02	1.1661E-02	1.1661E-02	1.0841E-02	1.0441E-02	0.9841E-02
CS196	0.0	1.2881E-01	1.7881E-01	1.288.								

ITEM 9

[illegible]

ACTIVITY		CYCLE 2-5		CYCLE 7-10		CYCLE 11-14		CYCLE 15-18		CYCLE 19-22		CYCLE 23-26		CYCLE 27-30		CYCLE 31-34		CYCLE 35-38		CYCLE 39-42		CYCLE 43-46		CYCLE 47-50		CYCLE 51-54		CYCLE 55-58		CYCLE 59-62		CYCLE 63-66		CYCLE 67-70		CYCLE 71-74		CYCLE 75-78		CYCLE 79-82		CYCLE 83-86		CYCLE 87-90		CYCLE 91-94		CYCLE 95-98		CYCLE 99-102		CYCLE 103-106		CYCLE 107-110		CYCLE 111-114		CYCLE 115-118		CYCLE 119-122		CYCLE 123-126		CYCLE 127-130		CYCLE 131-134		CYCLE 135-138		CYCLE 139-142		CYCLE 143-146		CYCLE 147-150		CYCLE 151-154		CYCLE 155-158		CYCLE 159-162		CYCLE 163-166		CYCLE 167-170		CYCLE 171-174		CYCLE 175-178		CYCLE 179-182		CYCLE 183-186		CYCLE 187-190		CYCLE 191-194		CYCLE 195-198		CYCLE 199-202		CYCLE 203-206		CYCLE 207-210		CYCLE 211-214		CYCLE 215-218		CYCLE 219-222		CYCLE 223-226		CYCLE 227-230		CYCLE 231-234		CYCLE 235-238		CYCLE 239-242		CYCLE 243-246		CYCLE 247-250		CYCLE 251-254		CYCLE 255-258		CYCLE 259-262		CYCLE 263-266		CYCLE 267-270		CYCLE 271-274		CYCLE 275-278		CYCLE 279-282		CYCLE 283-286		CYCLE 287-290		CYCLE 291-294		CYCLE 295-298		CYCLE 299-302		CYCLE 303-306		CYCLE 307-310		CYCLE 311-314		CYCLE 315-318		CYCLE 319-322		CYCLE 323-326		CYCLE 327-330		CYCLE 331-334		CYCLE 335-338		CYCLE 339-342		CYCLE 343-346		CYCLE 347-350		CYCLE 351-354		CYCLE 355-358		CYCLE 359-362		CYCLE 363-366		CYCLE 367-370		CYCLE 371-374		CYCLE 375-378		CYCLE 379-382		CYCLE 383-386		CYCLE 387-390		CYCLE 391-394		CYCLE 395-398		CYCLE 399-402		CYCLE 403-406		CYCLE 407-410		CYCLE 411-414		CYCLE 415-418		CYCLE 419-422		CYCLE 423-426		CYCLE 427-430		CYCLE 431-434		CYCLE 435-438		CYCLE 439-442		CYCLE 443-446		CYCLE 447-450		CYCLE 451-454		CYCLE 455-458		CYCLE 459-462		CYCLE 463-466		CYCLE 467-470		CYCLE 471-474		CYCLE 475-478		CYCLE 479-482		CYCLE 483-486		CYCLE 487-490		CYCLE 491-494		CYCLE 495-498		CYCLE 499-502		CYCLE 503-506		CYCLE 507-510		CYCLE 511-514		CYCLE 515-518		CYCLE 519-522		CYCLE 523-526		CYCLE 527-530		CYCLE 531-534		CYCLE 535-538		CYCLE 539-542		CYCLE 543-546		CYCLE 547-550		CYCLE 551-554		CYCLE 555-558		CYCLE 559-562		CYCLE 563-566		CYCLE 567-570		CYCLE 571-574		CYCLE 575-578		CYCLE 579-582		CYCLE 583-586		CYCLE 587-590		CYCLE 591-594		CYCLE 595-598		CYCLE 599-602		CYCLE 603-606		CYCLE 607-610		CYCLE 611-614		CYCLE 615-618		CYCLE 619-622		CYCLE 623-626		CYCLE 627-630		CYCLE 631-634		CYCLE 635-638		CYCLE 639-642		CYCLE 643-646		CYCLE 647-650		CYCLE 651-654		CYCLE 655-658		CYCLE 659-662		CYCLE 663-666		CYCLE 667-670		CYCLE 671-674		CYCLE 675-678		CYCLE 679-682		CYCLE 683-686		CYCLE 687-690		CYCLE 691-694		CYCLE 695-698		CYCLE 699-702		CYCLE 703-706		CYCLE 707-710		CYCLE 711-714		CYCLE 715-718		CYCLE 719-722		CYCLE 723-726		CYCLE 727-730		CYCLE 731-734		CYCLE 735-738		CYCLE 739-742		CYCLE 743-746		CYCLE 747-750		CYCLE 751-754		CYCLE 755-758		CYCLE 759-762		CYCLE 763-766		CYCLE 767-770		CYCLE 771-774		CYCLE 775-778		CYCLE 779-782		CYCLE 783-786		CYCLE 787-790		CYCLE 791-794		CYCLE 795-798		CYCLE 799-802		CYCLE 803-806		CYCLE 807-810		CYCLE 811-814		CYCLE 815-818		CYCLE 819-822		CYCLE 823-826		CYCLE 827-830		CYCLE 831-834		CYCLE 835-838		CYCLE 839-842		CYCLE 843-846		CYCLE 847-850		CYCLE 851-854		CYCLE 855-858		CYCLE 859-862		CYCLE 863-866		CYCLE 867-870	
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Burnup and time of discharge of commercial spent fuel, MIU in inventory

Year	Burnup, MWd/MTUHM															
	0-5,000		5,000-10,000		10,000-15,000		15,000-20,000		20,000-25,000		25,000-30,000		30,000-35,000		35,000-42,000	
	BWR	PWR	BWR	PWR	BWR	PWR	BWR	PWR	BWR	PWR	BWR	PWR	BWR	PWR	BWR	PWR
1970	5.6	21.4						1.1								
1971	41.5	12.2	3.3		3.0						9.7					
1972	98.1		10.1		0.7		4.0		7.8		9.2		22.1			
1973	9.1	47.8	16.3		26.2		27.8	24.2			22.5					
1974	57.6	45.6	6.2		150.2	104.1	13.4		3.8	13.9	45.0					
1975	43.0	8.4		9.3	45.7	186.3	157.3		21.9	70.8	22.8		19.7			
1976	0.7		48.9		93.4	16.5	149.3	169.2		83.8	39.8		22.7			
1977		35.2	52.1		31.4		198.5	110.9	103.7	103.4	133.0		85.5		6.4	
1978		95.2		1.8	3.7	51.1	128.2	67.7	229.1	49.0	4.8	385.3	66.5		62.1	
1979					10.7	26.0	89.4	118.3	162.1	55.5	173.9	271.0	244.6		31.6	
1980	15.4	4.8				0.9	47.5	24.1	427.6	29.3	110.0	271.9	268.6		28.8	
1981						25.5	42.5		260.5		153.3	263.2	423.1		16.0	
1982						0.4	40.1	79.5	88.9	47.2	259.6	160.9	387.9		21.2	
1983	10.2						45.6	63.9	53.8	61.8	378.6	384.0	21.4	285.0	66.3	
1984											385.0			735.0		
1985											425.0			764.0		

Source: DOE/RW-0006 Spent Fuel and Radioactive Waste Inventories, Projections, and Characteristics,
DOE, September 1984.

STATUS OF CONCEPTUAL DESIGN REPORT DOCUMENTS

<u>DOCUMENT</u>	<u>DELIVERY SCHEDULE</u>
Volume I - DESIGN DESCRIPTION	
Book I - Executive Summary	Sent
II - Design Description	October 23, 1985
*III - Design Description	
IV - Appendices	
 Volume II - REGULATORY ASSESSMENT DOCUMENT	 Herewith
 Volume III - DESIGN DRAWINGS	
Books I, II	Sent October 23, 1985
 Volume IV - CALCULATIONS	
Books I - XV	Available for inspection
 Volume V - COST ESTIMATE	
Book I - Summary	Herewith
Books II - X	Available for inspection
 Volume VI - DESIGN STUDIES	
Book I	Herewith
Book II	Sent October 23, 1985, Additions herewith
 Volume VII - GEOTECHNICAL DESCRIPTION	 Herewith
 *Replacement pages, Section 34	 Herewith
<i>53 Submittal pages</i>	
<i>84 Submittal pages</i>	
<i>+ Table, Contents</i>

STATE OF TENNESSEE
DEPARTMENT OF HEALTH AND ENVIRONMENT
CORDELL HULL BUILDING
NASHVILLE, TENNESSEE 37219-5402

Division of Radiological Health

Comments/Questions related to "Monitored Retrievable Storage Submission to Congress, Volume 2, Environmental Assessment for a Monitored Retrievable Storage Facility, January 1986." These questions should not be construed as being all inclusive or exhaustive but should be seen as indication of the areas where it is perceived that documentation is inadequate.

GENERAL COMMENTS

1. CHTRU, RHTRU are mentioned throughout the document but no specifics. Will this be only those wastes generated by the MRS operation itself?
2. Accident scenarios are a little tame.
3. Argument of reducing minimal radiation exposures to public while increasing occupational exposures and increasing total # of fatalities from non-radiological hazard (which far outweigh radiological risk) appears to work against proposed MRS facility.
4. Much verbage, little substance.

SPECIFIC COMMENTS (according to page number)

- S.2 "The facility can and will be licensed as safe by the NRC" seems to be an overstatement of what NRC licensing implies.
- S.14 Storage of spent fuel at MRS until heat load was acceptable for repository might conflict with our goal to have license condition restricting length of stay of any spent fuel. Also, how young and how hot could this fuel be in order to be accepted at an MRS ?
- S.16 "15, 000 MTHM" Relate MTHM to MTU.
- S.17 "Because there is nothing unusual in the licensing process of an MRS facility" seems absurd since it would be the first such facility licensed by the NRC.
- S.19 Shouldn't the one sentence paragraph near bottom of the page read "higher radiological doses..."?
- S.23 If only 320 acres are needed for the sealed storage cask design and 465 for the field drywell concept, why was 1100 acres minimum a criteria for site selection?

- 1.1.6 "After three sites..." Aren't the three sites already selected by the President?
- 1.2.1 "...the transportation effects would increase in the area surrounding the MRS facility." These effects, both radiological and non-radiological should be addressed specifically for Tennessee.
- 1.2.13 Shipments would "consist of primarily intact spent fuel assemblies." What else would there be?
- 1.2.20-23 How do the radiological risks compare to non-radiological risks? Which is the overriding factor? Appendix E (E-18) shows the MRS causes 19 more non-radiological fatalities.
- 1.2.36 What does a dose multiplied by an accident frequency represent?
- 1.2.38 " ...but the public dose would decrease by about a factor of two with an MRS facility." This addresses the public dose nationwide, but what would the additional dose to Tennesseans be?
- 2.1.2. Lists "commercial high-level waste" as a type of waste.
- 2.1.16 How can spent fuel be transported as "general commerce"?
- 2.1.18 Amount of LLW specified in pounds. We have never seen it expressed this way before. What is it in cubic feet?
- 2.1.19 Amount of LLW specified in gallons? See above.
- 2.1.20 HAW specified in pounds?
- 2.1.23 Why will decontaminated equipment be shipped offsite as either LLW or HAW?
- 2.2.1 We question "rigorous site screening and evaluation process".
- 2.3.3. Rather than just state what is specified in Reg Guide 1.25 also include best estimate and worst case estimate for release inventory.
- 2.3.3 Operating Accidents - Criticality accidents are described as "not possible" and are not considered in the design event classification. The reason given is that criticality is not possible, even in the presence of water, because the fuel is held too close together to become critical. However, the Class IV accident given for the field drywell involves shearing of the canister just enough to release trapped gases but not enough to release the fuel pellets themselves. It does not require much imagination to postulate a shearing action that would release the pellets and have the accident occur in the rain. Fuel at the appropriate distance apart in the presence of water will spontaneously become critical. This accident sequence meets the criteria of Class IV-events that are unlikely to occur but require consideration.

- 2.3.31 Why is Co-60 the only minor contributor to radiological doses? What other isotopes were considered?
- B.14 Discussion of exposure of maximally exposed individual is not understood.
- E.18 Table E.12 - There are more non-radiological traffic fatalities predicted for the MRS case than in the no-MRS case. If these numbers are true, they overwhelm any increase in safety to the public from the reduced exposure obtained from reduced truck miles.
- I.2 Table I.1 - Why are reactors able to handle spent fuel without exposing the public (less than 1 man-rem) while MRS handling exposes the public to 11 man-rem?
- I.7 Explain Table I.2.
- I.10 Question applicability of 1979 repository preclosure radiological accident projections.

Facility Design Workshop Report

This workshop held on 7/10/85 was chaired by Mike Mobley, DRH, TDHE. A list of attendees is attached.

Peter Gross, DOE MRS OR, discussed the general concept of the facility design. He emphasized the need for flexibility in the design so that it could adapt to changing needs and/or technology. Discussions were held on several specifics, e.g., depth of protection provided by design, specifics on air handling/filtering, monitoring of storage casks, availability of technology for operation, etc.

The only planned effluent from the plant is air which will be filtered via numerous mechanisms to ensure no radiological impact on the environment. One area of concern was whether adequate attention had been given non-radiological air impact, e.g., air emission from the concrete cask fabrication facility.

Conclusions reached by the group were:

1. This group will not do a specific design review. Agencies represented by the individuals in the group may have the authority and will do design specific reviews at the appropriate time.
2. A technical meeting should be scheduled to discuss more specific information on the conceptual design.
3. A facility for state personnel, i.e., Public Service personnel and Division of Radiological Health personnel, should be included in the design. This facility should include space and provisions, e.g., communications equipment for use as a transportation emergency operations for spent fuel shipment accidents.
4. A field trip to visit similar facilities in Idaho, Nevada, and Oak Ridge will be arranged.
5. The Department of Energy will provide the group with the following:
 - A. The Functional Design Criteria Document will be furnished to the group. This is a controlled document with numbered copies with set procedures for changes. Copies of changes provided for all controlled copies.
 - B. The Executive Summary Document will be provided when finalized in October.
 - C. The Regulatory Assessment Document will be provided when finalized in October.
 - D. The Environmental Assessment Document will be provided when finalized in December.

Submitted 7/22/85 by MHM

MHM/ah/1-40

Attachment

MHM 7/22/85

Facility Design

Mike Mobley
Heather Whitlow
Nick Fielder
Hap Macintire
Michael W. Walker
W. Dave Woods
Bobby Langford
Bill Carter
Peter Gross

TDHE--Division of Radiological Health
TDHE--Air Pollution Control
Conservation--Archaeology Division
TDHE--Water Supply
City of Oak Ridge--Staff
Ralph M. Parsons Co.
Tenn. P.S.C.
Tenn. P.S.C.
DOE, Oak Ridge MRS office

MHM/ah/1-40

STATE OF TENNESSEE
DEPARTMENT OF HEALTH AND ENVIRONMENT
CORDELL HULL BUILDING
NASHVILLE, TENNESSEE 37219

JAMES E. WORD
COMMISSIONER

June 26, 1985

Mr. Michael H. Mobley, Director
Division of Radiological Health
Department of Health and Environment
150 Ninth Avenue, North
Nashville, TN 37219-5404

Dear Mr. Mobley:

As you are aware, the Department of Energy has selected three candidate sites in Tennessee for the proposed construction of a monitored retrievable storage (MRS) facility for high level radioactive waste--primarily spent fuel. Governor Alexander has directed his Cabinet Council on Safe Growth, which I chair, to evaluate the Department of Energy's (DOE) proposal and to report to him after we assess the issues involved.

Recently, the Cabinet Council approved an evaluation plan by which the state will conduct this independent assessment. During our assessment, the state will examine DOE's basic assumptions and data supporting their conclusion that there is a need for an MRS facility; the criteria, logic and weightings used in selecting the three candidate sites; and the potential impacts -- environmental and economic -- of the proposed MRS facility on the state and its local communities. Also, the State Attorney General will examine constitutional issues and will identify Tennessee's legal options. This independent assessment program is ambitious and, unfortunately, must be condensed into a very short time frame. Nevertheless, we must ensure that our review is objective and professional and that our findings are based on competent technical review as well as social, economic and political factors.

For these reasons, I am appointing a Radioactive Waste Technical Advisory Panel to provide expert advice to the state. You have been highly recommended to me by your peers as a person with expertise in one or more of the technical disciplines needed in the review process. It is my pleasure to invite you to serve on this distinguished panel.

The primary charge to the panel will be to assist the state in its independent review of DOE assumptions, methodology, data and conclusions in regard to the need for an MRS and its integration into a national system. The panel will be asked to determine whether all viable alternatives have been examined by DOE and to

MRS

Mr. Michael H. Mobley, Director
Page 2
June 26, 1985

examine the site selection process and conclusions. Further, the panel will help the state to identify key issues upon which the DOE decision is based, to isolate these issues and scrutinize their validity. We also hope that the panel will help identify any voids in the work that DOE and its consultants have performed to date as well as identify areas in need of intensive analysis. Finally, the state will ask the panel to assist the Safe Growth staff in selecting scientists and/or consultants to carry out in-depth studies of key issues on behalf of the state.

I expect the panel to meet three to four times before January 15, 1986. The first meeting will focus on issue identification and consultant selection. The panel will meet again in late October to review the preliminary findings of the consultants and/or state review teams. Some members of the panel may participate in a briefing of state leadership shortly thereafter. A third meeting of the panel would examine the DOE's revised Need and Feasibility Report and the final Environmental Assessment which are proposed to be presented to Congress on January 15, 1986. Finally, the panel could be asked to advise the state on subjects to be addressed in an Environmental Impact Statement if Congress should authorize an MRS in Tennessee.

The first meeting of the panel will be on July 9, 10, and 11, 1985, in Nashville. On July 9, the DOE staff and consultants will meet at the Downtown Campus, Tennessee State University, to conduct a technically oriented briefing for state study project leaders and their consultants on five topics: the role of the MRS, facility description, site selection, transportation, and the role of the state. On July 10, concurrent workshops on these topics will be scheduled in the morning. In the afternoon DOE is soliciting specific input from the state on the proposed scope and content of the Environmental Assessment, now in preparation. Members of the panel may find it informative to observe the DOE briefing and hear the dialogue between DOE staff/consultants and the state evaluation team. The first meeting of the Technical Advisory Panel will be on July 11, in Room 347, Cordell Hull Building, beginning at 9:00 a.m. and adjourning no later than 4:00 p.m. This meeting will be for the panel members and Safe Growth staff; no DOE personnel will be present.

Although I realize that this is short notice, I sincerely hope that you can be in Nashville for the entire three days and participate fully in the DOE/state interactions. However, if prior commitments make it impossible to be present for three days, we hope that you can attend on July 11 when the panel will get down to specifics. We will reimburse travel expenses incurred in attending, and will assist you in finding comfortable accommodations. Staff support for the panel will be provided by Ben L. Smith and Ruth Neff; they may be reached at 615/741-5782.

A packet of information will be mailed to you soon. It includes the Preliminary Needs and Feasibility Report, the Site Selection Report, the Table of Contents reflecting the scope of the Environmental Assessment, and DOE's tentative agenda for the briefing on July 9 and the workshops on July 10. Enclosed is a list of the members invited to serve on the Radioactive Waste Technical Advisory Panel.

Mr. Michael H. Mobley, Director
Page 3
June 26, 1985

I greatly appreciate your willingness to share your knowledge and judgment with the State of Tennessee as we prepare for this important decision. We must define an appropriate balance between our responsibility and role in a national waste management system and our responsibility to protect the interests of the people of Tennessee.

Sincerely,

A handwritten signature in cursive script, appearing to read "James E. Word".

JAMES E. WORD
Commissioner

JEW/cmj

Enclosures

RADIOACTIVE WASTE TECHNICAL ADVISORY PANEL
CABINET COUNCIL ON SAFE GROWTH
JUNE 25, 1985

Dr. Michael S. Bronzini, Director
Transportation Center
University of Tennessee
Knoxville, TN 37996-0700
(615) 974-5255

Dr. E. William Colglazier
Energy, Environment and Resources Center
University of Tennessee
327 South Stadium Hall
Knoxville, TN 37996-0710
(615) 974-4251

• Mr. James L. Cross
Executive Assistant to the Manager
of Power and Engineering
Office of Power
Tennessee Valley Authority
500 A Chestnut Street, Tower II
Chattanooga, TN 37401
(615) 751-3907

Mr. Anton A. Fuierer
Director of Special Projects
Rochester Gas and Electric Corporation
89 East Avenue
Rochester, NY 14649
(716) 724-8737

Mr. Robert J. Halstead
Energy Facilities Analyst
Division of State Energy
Wisconsin Department of Administration
P. O. Box 7868
Madison, WI 53707
(608) 266-9810

Mr. Ray Hoskins
Office of Power, Special Projects Branch
Tennessee Valley Authority
303 Krystal Building
Chattanooga, TN 37401
(615) 751-2731

Mr. Terry R. Lash, Director
Illinois Department of Nuclear Safety
1035 Outer Park Drive
Springfield, IL 62704
(217) 546-8100

Dr. Diana Liverman
Department of Geography
Science Hall
University of Wisconsin
Madison, WI 53706
(608) 262-1855

Dr. James McKenzie
Union of Concerned Scientists
1346 Connecticut Avenue, NW
Washington, DC 20036
(202) 296-5600

Mr. Michael H. Mobley, Director
Division of Radiological Health
Department of Health and Environment
150 Ninth Avenue, North
Nashville, TN 37219-5404
(615) 741-7812

Mr. James Moegling
Office of Power, Special Projects Branch
Tennessee Valley Authority
303 Krystal Building
Chattanooga, TN 37401
(615) 751-2731

Mr. Robert H. Neil, Director
Environmental Evaluation Group
State of New Mexico
320 East Marcy Street
Santa Fe, NM 87503
(505) 827-8280

Mr. John Nevshemal
Westec Services, Inc.
P.O. Box 765
Muscatine, IO 52761
(319) 264-5533

Ms. Donna Martin
Office of Environmental Quality
Tennessee Valley Authority
210 Summer Place Building
309 Walnut Street
Knoxville, TN 37902
(615) 632-6578

Mr. Dan Shilstat
Assistant to the Commissioner
Tennessee Department of Conservation
Customs House
701 Broadway
Nashville, TN 37219
(615) 742-6753

Dr. Robert E. Stammer, Jr.
Department of Civil and Environmental Engineering
Vanderbilt University
Nashville, TN 37235
(615) 322-3435

Robert E. Stammer, Jr.

Mr. Robert Tomonto
Florida Power and Light
P. O. Box 0029100
Miami, FL 33102
(305) 552-3497

Mr. Charles E. Whittle, Director
Institute for Energy Analysis
Oak Ridge Associated Universities
P.O. Box 117
Oak Ridge, TN 37831-0117
(615) 576-3171

Mr. Robert H. Wolle
Executive Director
Southeast Compact Commission
Route 3, Murray Lane
Brentwood, TN 37027
(615) 373-1336

Mr. Coleman Woodall
Vice-President
Technical Analysis Division
Nuclear Assurance Corporation
5720 Peachtree Parkway
Norcross, GA 30092
(404) 447-1144

Mr. Dennis Reisenweaver
General Dynamics
Reactor Plant Services
Eastern Point Road
P.O. Box 1147
Groton, CT 06340
(202) 446-3246

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FINAL REPORT
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TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT

December 17, 1985

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