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Memorandum to R. Bernero from G. Arlotto, dated March 31, 1992
Subject: Transmittal of Trip Report to France and England

Please replace previous trip report. The report was sent out in the wrong order.

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MAR 3 1 1992

MEMORANDUM FOR: Robert M. Bernero, Director
Office of Nuclear Material
Safety and Safeguards

FROM: Guy A. Arlotto, Deputy Director
Office of Nuclear Material
Safety and Safeguards

SUBJECT: TRANSMITTAL OF TRIP REPORT TO FRANCE AND ENGLAND

Transmitted herewith is a report of our visit to France (November 10-14, 1991) and England (November 15-19, 1991) to meet with government representatives and tour radioactive waste processing and disposal facilities. This report was prepared jointly by R. Bangart, P. Lohaus, J. Linehan, J. Youngblood, and myself.

Original signed by G. A. Arlotto

Guy A. Arlotto, Deputy Director
Office of Nuclear Material
Safety and Safeguards

Enclosures:
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OFC :HLWM	:HLWM	:LLWM	:LLWM	:NMSS
NAME:JLinehan	:BJYoungblood	:RBangart	:PLohaus	:GArlotto
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TRIP REPORT
by
Guy A. Arlotto, Richard L. Bangart, John J. Linehan,
Paul H. Lohaus, and B. J. Youngblood

ON THEIR VISIT TO FRANCE AND ENGLAND

During the period November 10-14, 1991, Mssrs. Arlotto, Bangart, Linehan, Lohaus and Youngblood met with French representatives in Fontenay-aux-Roses. The meeting was preceded by visits to the reprocessing facility at the la Hague industrial complex, and visits to the low-level radioactive waste (LLW) disposal facilities at Centre de la Manche and Centre de l'Aube. During the period November 15-19, 1991, Messrs. Bangart and Lohaus met with British representatives in London and visited waste processing and LLW disposal facilities at Sellafield. A discussion of each site visit and meeting follows:

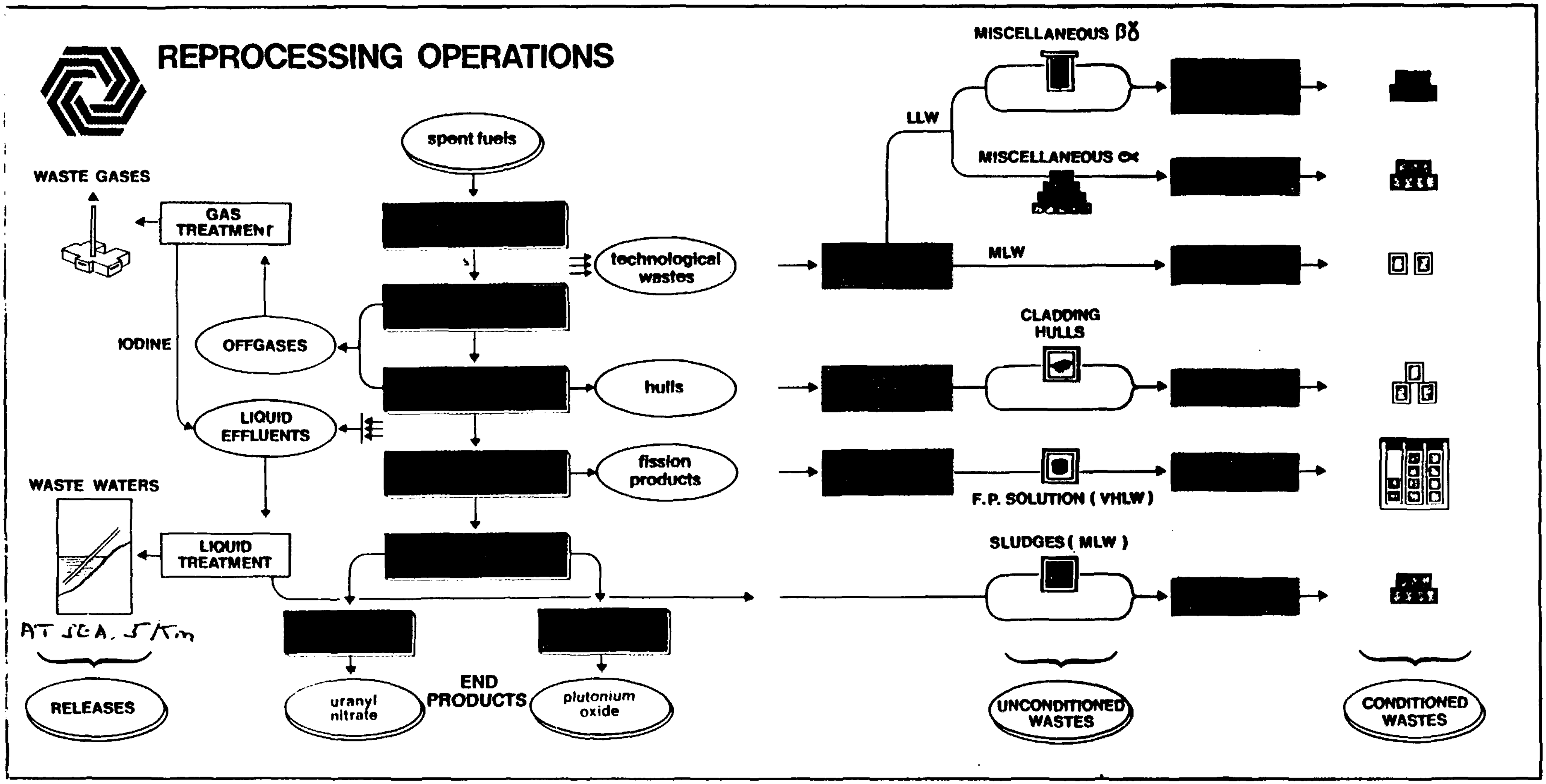
Visit to la Hague Industrial Complex

On November 12, 1991 we visited the la Hague Reprocessing Plant. We first met with Mr. Roger, of public relations, and Mr. Pisjelman, of plant operations, who provided a general history and description of the la Hague Facility. We then toured the reception and storage facility and the vitrification facility.

The la Hague complex which is located 25 kilometers west of Cherbourg at the tip of the Contentin peninsula, is the largest reprocessing facility in the world. It opened in 1966 and has reprocessed fuel from gas-cooled reactors, fast breeder reactors and light water reactors (LWR). Since 1987, it has been dedicated to reprocessing LWR fuel. The UP2 plant, which has one mixed oxide fuel line, started in 1976, has a capacity of 400 TU/yr and is expected to be increased to 800 TU/yr in 1994. The UP3 plant, started in 1990, has a capacity of 800 TU/yr. By comparison, the BNFL has a capacity of 1,000 TU/yr, according to COGEMA officials. The la Hague facility is capable of producing 600 canisters/year of vitrified waste.

The basic reprocessing (Figure 1) consists of reception and storage of waste, decladding and shearing, dissolution and clarification, fission product separation, and treatment of U and Pu to form uranyl nitrate and plutonium oxide. The uranyl nitrate and plutonium oxide are then recycled to fuel fabrication facilities. During our tour we visited the fuel reception and storage facilities and the vitrification facility. Both facilities were extremely clean and made extensive use of robotics. Wastes (LLW, Intermediate, and HLW) generated at the site are treated and processed on-site by vitrification, concrete solidification, or bituminization. All wastes generated by reprocessing of spent fuel from other countries are returned to their sources. HLW consisting mainly of fission products is incorporated into glass through vitrification. Vitrification started in June 1989 for the UP2 line. Concentrated fission product solutions from reprocessing are cooled in

ENCLOSURE



REPROCESSING OPERATIONS
spent fuels
WASTE GASES
GAS TREATMENT
technological wastes
IODINE
OFFGASES
hulls
LIQUID EFFLUENTS
fission products
WASTE WATERS
LIQUID TREATMENT
AT SEA, 5 Km
RELEASES
uranyl nitrate
END PRODUCTS
plutonium oxide
MISCELLANEOUS βγ
LLW
MISCELLANEOUS α
MLW
CLADDING HULLS
F.P. SOLUTION (VHLW)
SLUDGES (MLW)
UNCONDITIONED WASTES
CONDITIONED WASTES

FIGURE 1

tanks by water, calcined, and then mixed with glass frit in a furnace for vitrification. The vitrified wastes are poured into stainless steel containers and stored in air cooled pits pending shipment to a final geologic repository. Little specific information was available on process controls and associated specifications for the vitrified glass. Specifications, for the glass are proprietary and set by COGEMA and the customer, which is ANDRA in France.

High-level wastes consisting of fuel cladding and structural materials, which are encapsulated in concrete and packaged in stainless steel drums, and intermediate-level wastes consisting of sludges and IX resin, which are encapsulated in concrete grout and packaged in concrete containers, are stored for ultimate disposal in a deep geologic repository. Miscellaneous low-level wastes are compacted and coated with cement.

Visit to Centre de la Manche LLW Disposal Facility

We next met with M. Roger, Public Relations and Patrice Voizard, Manager, la Manche disposal facility at the la Manche Information Center. Mr. Voizard provided a general description of the la Manche facility using a scale model of the facility that was available at the information center and selected viewgraphs. The discussion was followed by a brief bus tour of the disposal area. Due to high winds and limited remaining time, we did not leave the bus for direct observation of site activities.

The site at la Manche has a complex geology, is located very close to the sea, and has a very limited buffer area between the active disposal area and the unrestricted area boundary. The total site area is about 12 hectares. In some cases, there is only a 1-2 meter distance between completed disposal units and the unrestricted area site boundary.

The average volume of waste disposed of during 1990 was 20,000 cubic meters down from 35,000 cubic meters in 1988 due to volume reduction efforts by generators that are being encouraged by French authorities. The site is nearing completion and is expected to close within two years. The expected total volume for the 12 hectare site will be about 400,000 cubic meters.

Radioactive waste in France is divided into three general categories: Low, Intermediate and High. Low-level waste contains short lived beta and gamma emitting radionuclides with half lives less than or equal to 30 years and which will decay to background levels within a 300 year timeframe. French authorities acknowledge the presence of longer lived alpha and beta/gamma emitting nuclides in LLW, such as americium-241 and iodine-129, but noted concentrations are kept at low levels. A limit of 0.01 curies of alpha activity per ton of waste averaged over the site and 0.1 curies alpha activity per package is applied. A higher limit of 0.5 curies per package is allowed on a case by base basis. (See further discussion below). Intermediate level wastes include higher activity "LLW" such as sludges from reprocessing operations and higher concentration alpha wastes.

The la Manche facility design involves use of below grade concrete vaults where the highest activity LLW is placed and backfilled with concrete. The packages are placed in successive layers and a final steel reinforced concrete cover is placed on top and then covered with asphalt. The vaults are constructed in pairs with a two meter distance between individual vaults. This void area is used for placement of high surface dose rate packaging. After placement, this area is also backfilled with concrete to form a final solid concrete monolith. A drainage and monitoring channel is provided under each vault which is accessible through concrete "inspection pits."

Compactable waste in 55 gallon steel drums is compacted at the la Manche facility, placed inside concrete containers and then backfilled with concrete. About ten, 55 gallon drums can be placed into one concrete container. The containers, each weighing about four tons, are placed four high (about six meters in height) on top of and around the perimeter of the finished vaults.

When container placement is complete, a free draining backfill material (sand and gravel) is used to backfill the entire area of stacked containers and a final cap of clay, sand, soil and vegetation is placed and mounded above the completed units. The completed disposal area will be maintained under government surveillance and monitoring for 300 years at which time the French consider it would be available for release for unrestricted use.

Additional details about the Centre de la Manche are provided in several background documents on file in the Division of Low-Level Waste Management and Decommissioning. (See documents 1-3 of Enclosure 1). Additional details about the overall French organization and approaches followed for LLW disposal are provided below under meeting with French representatives.

<u>Visit to Centre de l'Aube LLW Disposal Facility</u>

On November 20, 1991, Mssrs. Arlotto, Bangart, Linehan, Lohaus and Youngblood conducted a site visit at the Centre de l'Aube LLW disposal facility. The facility is about one hour by car from Troyes. Troyes is about two hours east of Paris by train. We were joined on the train to Troyes by Mr. Jean Hulst, Head of International Relations, Nuclear Installations Safety Directorate (DSIN) and Jean Scherrer, Deputy Director, Ministry in Charge of Industry, (DSIN). Mr. Scherrer was, by chance, traveling to Troyes for a meeting with DSIN officials on a separate matter. He was an active participant in the site selection and public relations process that was followed in the selection and licensing of the l'Aube site and we used the opportunity to learn more about that process. The process has involved about seven years of active site investigation, licensing and public relations activities with the local surrounding communities. Mr. Scherrer was principally active in the public relations part of the program. He said that initial strong local opposition against the facility was moderated to "acceptance of the facility" through extensive face to face meetings with local mayors and elective officials, town meetings and active use of a 30 member citizen's advisory committee to provide advice and feedback to French authorities on issues of concern to local citizens. He said he had personally spent a significant amount of his time throughout that period meeting with various officials and citizens to discuss the facility, how it would be designed and operated, past safety record of la Manche and long term safety significance of the l'Aube facility. He said the process had worked in that the facility was now accepted by the local communities and was no longer subject to direct public opposition.

Upon arrival at l'Aube, we were joined at the Information Center by Gerard Bazot, Director of the l'Aube facility, Gilles Chevrier, Director of Construction at l'Aube, Catherine Mucyn, Public Relations, and Marc Oliver, l'Aube Operations staff. Dr. Bazot provided background information and answered a number of questions about the facility. The facility is being designed to dispose of 1,000,000 cubic meters of LLW over an approximate 30-40 year projected operating period. He noted the French have been active in reducing the volume of waste produced and they were looking for further reductions in volume from about 30,000 cubic meters to 20,000 cubic meters per year. The site is about 200 kilometers east of Paris near the town of Soulaines-Dhuys and covers an area of about 100 hectares. About 30 hectares will be used for active disposal operations.

Dr. Bazot noted the site have been selected because of desirable hydrologic conditions and stated there were a number of differences at l'Aube as compared to la Manche which provided greater protection and safety assurance. These included:

1. Site characteristics-Complex at la Manche, simple at l'Aube. He noted the site at l'Aube contained an upper homogenous sandy layer where disposal would take place, which was underlaid with a homogenous impermeable clay layer that served to isolate the disposal area from an underlying aquifer. The site drained in one direction to one central surface discharge point, an adjoining small river. He noted the river provided an easy point for monitoring and also would provide high dilution if any releases resulted from facility operations. He also noted the site was located in an area of low seismicity and contained no known natural resources.

2. l'Aube has a greater buffer zone.

3. Waste was exposed to weathering during operations at la Manche while at l'Aube all active disposal operations are covered by a moveable weather protection building.

4. The galleries (concrete vaults) are constructed ahead of time at l'Aube rather than as a part of active disposal operations as at la Manche.

5. Most operations, including placement of waste in vaults, is handled remotely with cranes and cameras.

6. All water, both surface drainage, water collecting in active vaults and water percolating into completed vaults, is collected and measured for contamination before release. Surface drainage is collected in an on-site 30,000 cubic meter holding basin. Each vault includes an underground drainage system which would collect any water collecting in vaults during operations or infiltrating into completed disposal units after closure. If contamination is detected above certain levels, the water is processed, solidified and disposed. Otherwise, it is sent to the holding basin and released to the river.

The main features of the facility design and operations include:

(a) a concrete basemat;
(b) individual concrete vaults constructed on top of the basemat measuring about 25 meters square;
(c) use of a moveable weather shield building, which entirely covers one disposal vault, during operations. The building also houses a remote/shielded operations area, cranes for movement and placement of containers, remote viewing cameras and a laser scanning/computer device to read and record the bar coded number of individual packages (and their placement location) as they are placed into the vault;
(d) use of a gravel backfill for concrete containers and concrete backfill for metal containers;
(e) a concrete cap for completed vaults with a plastic coating applied to the cap and sides;
(f) earth mounded backfill of multiple vaults;
(g) final engineered cover consisting of several layers including sand drainage layers, synthetic polymer and clay barriers and top covering of soil and vegetation;
(h) use of two principal drainage systems-one above ground to handle surface drainage and a second below ground to collect any infiltration; and
(h) 300 years of government monitoring and surveillance before release for unrestricted use.

Document Numbers 4 and 5 of Enclosure 1 provide details of the site, design and operations. Copies of these documents are on file in the Division of Low-Level Waste Management and Decommissioning.

Following the introductory briefing, C. Mucyn provided a tour of facilities which included constructed vaults; weather shield building; underground drainage, collection and monitoring system; waste package receiving and grouting facility; compaction facility; and remote central operations facility. Dr. Bazot joined us at the central operations facility where we viewed individual operating stations for the compactor, grout facility, weather building/waste placement unit, and health physics support. Each station was equipped with remote visual video readout equipment capable of viewing actual operations at each area and computer terminal/monitors to follow and check on the status of work in progress. With the exception of the compaction facility, l'Aube staff were involved in start-up type operations and testing activities. Actual disposal operations had not yet started and staff anticipated initial operation in as early as three weeks. The compaction facility was under active construction and would likely start at a later time.

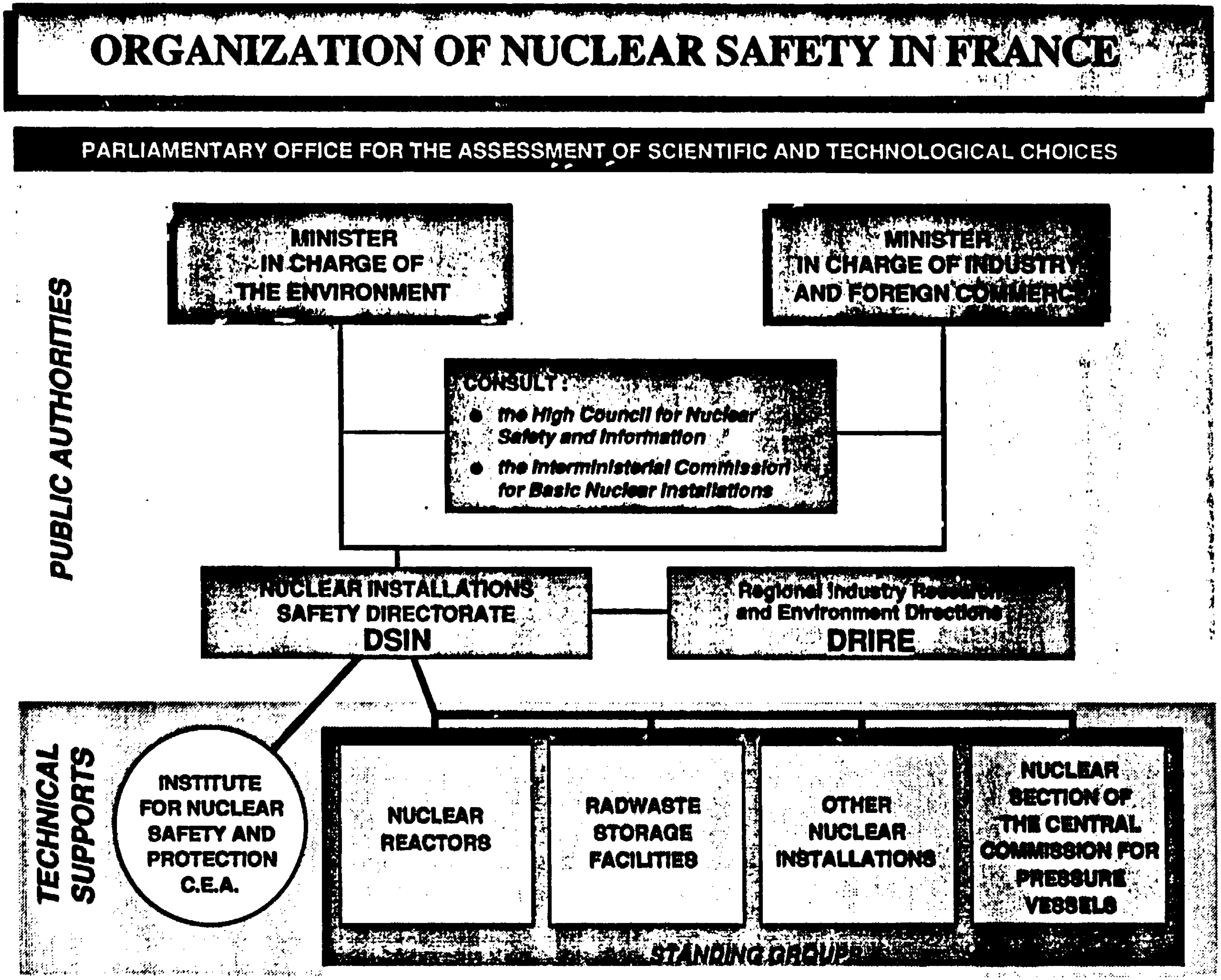
Meeting with French Representatives

On November 14, 1991, Mssrs. Arlotto, Bangart, Linehan, Lohaus, and Youngblood met with French counterparts at their offices in Fontenay-aux-Roses. The meeting agenda and a list of meeting attendees is attached as Enclosure 2. French attendees included representatives from both the Nuclear Installations Safety Directorate (DSIN), and Institute of Protection and Nuclear Safety (IPSN). Following introductions and introductory remarks by Jean Hulst, Head of International Relations, DSIN, Dr. Jean Christophe Niel, Head of Fuel Cycle Division, DSIN, started the discussion with an overview of the structure of the French organization.

Figure 2 provides the "Organization of Nuclear Safety in France." DSIN, the French safety authority which comes under the Minister in Charge of Environment and the Minister in Charge of Industry and Foreign Commerce is the French counterpart to the NRC. DSIN is provided expert technical support by the Institute for Nuclear Safety and Protection (IPSN) which is part of the French Atomic Energy Commission (CEA). While CEA is mandated to promote the use of nuclear energy in the sciences, industry, and national defense, the head of IPSN is appointed by a minister over DSIN and IPSN support to DSIN is provided by a group totally independent of other CEA activities.

DSIN is also totally independent of COGEMA, the French nuclear fuel cycle compnay which is part of the industrial group owned and headed by CEA, and ANDRA, the French national waste management agency. ANDRA conducts research and performs tests on processes for the long term management of radioactive waste; establishes technical specifications for waste treatment packages and ensures that they are applied; and designs, sites, constructs, and operates radioactive waste disposal facilities.

The French regulatory approach is similar to that followed in the U.S. Ministerial orders set overall policy and safety goals. DSIN establishes implementing regulations termed Basic Safety Rules (BSR) which define specific safety objectives to be achieved and licensing procedures. The site and plant operators propose and implement technical approaches to achieve the objectives and can propose alternative means to achieve the safety aims underlying the rules. Regulatory agencies review and approve operator proposals for compliance and check on implementation through inspections of ANDRA and the radioactive waste producers. One area of difference identified relates to the development of regulatory guidance, such as technical positions and regulatory guides. The French regulatory agencies do not usually develop supporting regulatory guidance but rather leave such details up to the operators to develop and propose.


ORGANIZATION OF NUCLEAR SAFETY IN FRANCE
PARLIAMENTARY OFFICE FOR THE ASSESSMENT OF SCIENTIFIC AND TECHNOLOGICAL CHOICES
PUBLIC AUTHORITIES
MINISTER IN CHARGE OF THE ENVIRONMENT
MINISTER IN CHARGE OF INDUSTRY AND FOREIGN COMMERCE
CONSULT:
the High Council for Nuclear Safety and Information
the Interministerial Commission for Basic Nuclear Installations
NUCLEAR INSTALLATIONS SAFETY DIRECTORATE
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RADWASTE STORAGE FACILITIES
OTHER NUCLEAR INSTALLATIONS
NUCLEAR SECTION OF THE CENTRAL COMMISSION FOR PRESSURE VESSELS
STANDING GROUPS

FIGURE 2

In the LLW area, the basis safety rules have two main objectives:

1. Prevent radioactive release from the disposal site to the biosphere.

2. Control the nature and quantity of radionuclides disposed such that the site can be released for unrestricted use at the end of a limited 300 year surveillance period.

Waste is divided into three general classes: Class A or LLW; Class B or intermediate level waste; and Class C or high level waste (HLW). LLW is defined as waste that contains beta and gamma emmitting radionuclides with a half life less than 30 years and low concentrations of long lived radionuclides. Specific concentration limits are established for wastes containing alpha emitting radionuclides; 0.1 curies per ton for any given package and 0.01 curies per ton for all packages at a site. (Special approval can be granted for packages containing 0.5 curies per ton for any single package). Although no specific concentration limits are established for longer lived beta and gamma emitting radionuclides, specific package limits are established and specific inventory limits are established for specific radionuclides on a site specific basis. This is an area where further discussion with the French to better understand their approach and basis for any limits established would be of direct benefit to NRC's program. Similar site specific inventory limits would be established for sites licensed by NRC and the Agreement States for mobile radionuclides.

Class B or intermediate level waste contains high concentrations of long lived radionuclides with low thermal release and principally consists of hulls and other wastes generated as a part of reprocessing operations. Such wastes are solidified or bound in a cement or bitumen matrix and are presently held in storage pending availability of a deep mined repository for disposal.

Class C wastes are primarily the HLW from reprocessing that are vitrified and presently stored pending disposal in the repository, as well as exotic irradiated fuel. The activity of vitrified waste averages 10^3 curies alpha/beta and 250 curies gamma per liter of glass. The makeup of the vitrified waste by mass is 45% U, 20% Am, 3% Pu, 2% Np, 1.5% Cm, and 1.5% fission products. The French estimate there will be 1,500,000 m^3 of Class A, 150,000 m^3 of Class B, and 5000 m^3 of Class C wastes by 2020.

The French rely on a series of multiple barriers to isolate LLW and to protect against contact of water with waste which include the waste form and packaging, natural site characteristics, facility design and operations and surveillance after closure. A great deal of emphasis is placed on the form of the waste, packaging and solidification. Homogeneous wastes such as liquids and powders are required to be solidified and heterogenous wastes are "overcoated" or placed in a container which is then filled with concrete.

The Basic Safety Rules establish requirements on the form and processing of waste which must be met by ANRDA. The details of these requirements and details of their approval process were not covered as a part of these discussions. NRC staff should review this area in further detail with the

French as a part of future discussions. The Rules also require that ANDRA, the disposal facility operator, establish formal agreements with each generator about the processing, form and content of waste to be shipped for disposal. Discussion with ANDRA staff at l'Aube indicate that ANDRA staff also conducts routine inspections at each generator's facility to ensure conformance with the agreements.

As part of their approval process for the l'Aube facility, the Service for Safety Evaluation of Facilities for Treatment, Interim Storage, and Disposal of Waste carried out and documented a safety analysis for the facility. The life of the site is divided into three periods, 30 year operating period, 300 year institutional control period and a period termed post-control phase where the site is assumed to be released for unrestricted use. During each phase, specific exposure scenarios are assumed to occur including natural events such as flooding, intrusion of plants and animals, intrusion by man, accidents such as a dropped container and migration through groundwater. Some of the basic concepts considered and specific scenarios analyzed are presented in the viewgraphs identified as Document Number 6 of Enclosure 1. This is an area where further staff interaction with the French as to specific approaches followed, detailed assumptions used and their bases as well as understanding of their overall performance assessment methodology would be of benefit to the LLW program. For example, the IPSN has also developed degradation curves for concrete barrier performance which they apply in their analysis. The curves allow for a factor of credit for concrete for a 300 year period. Further discussion in this area would be of assistance in helping address similar issues in NRC's program on the degree of and length of time that credit can be given to engineered barriers.

The French HLW program has been guided by the following principles: reprocessing is a satisfactory option for irradiated fuel management; development of a repository should include examination of several rock types and on-site confirmation; and the waste management research program should begin exploration of sites quickly, define the criteria for choosing a site, and develop an understanding of radioactivity transfer. ANDRA had conducted a geologic inventory from 1983-1987 to find the most stable and most homogeneous regions, resulting in the selection of four sites in 1987 in clay, granite, schist, and salt. The ANDRA program was then scheduled to select a site for an underground laboratory based on subsurface geophysical measurements and drillings, operate the laboratory and conduct in-situ measurements on hydrogeology, geochemistry, and thermal and mechanical properties, and finally create a repository. The program for selection of a geologic repository site has been on hold since 1990 due to public opposition after announcement of the decision to select a site for an underground laboratory. In 1990 and 1991 there were several studies, evaluations or findings by various groups. The basic conclusion to date was that R and D in the laboratories should go on. Specific findings or advice of the various groups that were not totally consistent with the U.S. program were the necessity to study more efficient separation and transmutation, the need to study more than one site, and the site of the laboratory will not accept subsurface storage of waste. There is action needed by the parliament on these studies and findings for site or field programs to move ahead. The French indicated that there will probably be two underground laboratories in two different media.

For HLW the Basic Safety Rules address:

1) general rules for production, control, treatment, conditioning processing, packaging, confinement, and temporary storage of waste from PWR fuel reprocessing;

2) high activity vitrified waste, bitumen solidified waste, cement solidifed waste; and

3) safety aims for the study and conception of an underground disposal facility, including protection of man and environment, ALARA, radioprotection criteria of an individual dose limit of 0.25 mSv per year for ≥ 10,000 years, defense in depth through three barriers, conditioned packages, engineered barriers, and the geologic formation, and post closure safety criteria, such as site stability and no valuable natural resources, that appear similar to the siting criteria in 10 CFR 60.122.

One of the particular areas we focused on during our discussions was the process controls and specifications for the HLW vitrified glass. However, due to the proprietary status of this information we were only able to obtain very general information. Process controls and glass specifications are developed based on data developed during the research phase, prior to start of vitrification. During fabrication there is radiochemical analysis on the supply vessel of the calciner and measurements of mass of solution to be calcined, the mass of glass matrix/frit and the mass of flowing glass. The specifications which were not available addressed process description, form and content of additives, quality parameters, and quality of product. There is a research program being planned in 1993 that would involve one shot sample taking and chemical analysis. In addition, there will be studies of the long-term behavior of the vitrified glass waste in different barriers and to define behavior models of leaching. We should make attempts to follow-up on this testing and studies to see what data, that may be of significance to waste pack performance in a repository, can be obtained.

Introduction of NRC LLW and HLW Programs

Guy Arlotto introduced NRC's LLW and HLW programs. He provided background information on major legislation and statutory bases supporting each program area, discussed overall NRC organization and responsibilities with specific reference to the LLW and HLW Divisions in NMSS, and highlighted the importance and need for interface with other federal and State organizations such as DOE, EPA, LLW compacts and Agreement States. A copy of the set of viewgraphs used is include as Enclosure 3.

U.S. Commercial LLW Program

Richard Bangart and Paul Lohaus next discussed the U.S. commercial LLW program using the set of viewgraphs included as Enclosure 4. Areas of discussion included: historical perspectives of the commercial LLW program, Low-Level

Radioactive Waste Policy and Policy Amendments Acts of 1980 and 1985, current status of State and compact efforts to site new LLW disposal facilities, LLW disposal facility designs being considered and applied by States, NRC's 10 CFR Part 61 licensing requirements, and NRC's technical position and topical report review program for waste form stability.

U.S. Commercial HLW Program

B. Joe Youngblood and John Linehan next discussed the U.S. commercial HLW program using the viewgraphs included as Enclosure 5. Areas of discussion included: the Nuclear Waste Policy Act of 1982 and Amendments Act of 1987; NRC and Center for Nuclear Waste Regulatory Analyses organizations; NRC and Environmental Protection Agency regulations; Department of Energy's (DOE) Siting Guidelines; Status of DOE Repository and Monitored Retrievable Storage activities; NRC regulatory activities; and DOE's vitrification activities.

Summary of French Visits and Meetings

The site visits to la Hague, la Manche and l'Aube, and the meeting with French authorities, have each been of benefit to the LLW and HLW programs. Several major benefits are identified below. It is important to recognize, however, that the visits and meeting were of limited duration and the initial information obtained about the French program has pointed to a clear need for further discussion, dialogue and technical interchange. To be of most benefit to the NRC LLW and HLW programs, such exchange should take place in the near future with meetings suggested in the summer to fall timeframe. Specific benefits from the visit follow with focus on the benefits to be gained from further interchange:

- Staff had an opportunity to observe first hand and to discuss the design, construction and operational practices for the French "earth mounded concrete bunker "disposal alternative, initially applied at la Manche and as modified and improved at l'Aube. This type of disposal alternative, or one very close to it, has been proposed for use at several new State facilities. The knowledge gained from the site visits, particularly from the l'Aube facility, can be applied in the development of guidance for licensing alternatives and in the provision of technical assistance to Agreement States licensing alternative disposal techniques.

- The French, as part of their safety analysis in support of licensing the l'Aube facility conducted a performance assessment analysis which included pathway analysis, exposure calculations, analysis of barrier performance and groundwater transport calculations. A further exchange of information in this area, particularly details on how barrier performance is considered and handled in their performance assessment would be of benefit given the limited experience in the U.S. in this area.

- The French have a great deal of experience with use of concrete as a solidification media, as an encapsulation media, as a media for container material and also as a barrier material in the construction of disposal facilities. A further exchange of information in this area would be of benefit to the NRC staff in assisting in the review of specific applicant proposals and in the development of guidance regarding use of concrete as a waste form and barrier material.

- The French have extensive experience in the remote handling, processing, and solidification of LLW including laser reading of bar codings on packages and computer tracking. This information would be of benefit regarding review of similar types of facilities in the U.S. and in support of the data base/uniform manifest rule and electronic transfer of manifest data.

- The French have several "regulatory philosophical" differences in their program, the most notable being the ability to use a leachate drainage, collection, monitoring and release system and the reliance on institutional controls with active maintenance for a 300 year period following site closure. Similar approaches would likely be precluded by current NRC and Agreement State regulatory provisions. NRC staff could benefit from a better understanding of the bases and rationale for these differences.

- Due to the status of the French HLW program, the major areas where the French have extensive experience are in vitrification of HLW and packaging and processing of waste similar to greater-than-Class C in the U.S. We should pursue further discussions and seek to obtain any information in these areas that relates to ultimate waste form/waste package performance in a repository. While there is information to be shared and gained related to performance assessment, this can probably be affected through our involvement in the OECD - Nuclear Energy Agency activities and other international activities.

Meeting with British Representatives and Site Visit to Sellafield and Driggs

During the afternoon of November 15, 1991, Mssrs. Lohaus and Bangart met with representatives of Her Majesty's Nuclear Installations Inspectorate (NII) of the British Health and Safety Executive. Representing NII were James Reed, Superintending Inspector, Policy Branch; Dr. Ray Winyard, Principal Inspector, Policy Branch, and Desk Officer for Radioactive Waste Management; and Mr. J. S. Griffiths, Principal Inspector. Broadly speaking, NII is responsible for enforcement of the nuclear-related legislation in Great Britain as it applies to major nuclear facilities, including nuclear power plants, fuel manufacturing and reprocessing centers, and waste management (high, intermediate, and low level) disposal facilities.

Beyond this broad general responsibility, however, which is similar to that of the NRC's, the British and U.S. regulatory systems depart dramatically. For example, NII's program is much less prescriptive than the NRC's program and contain's general requirements in regulations with much less supporting formal guidance, like Regulatory Guides. The applicant/licensee must relatively independently propose design/construction/operations information to NII that is sufficient to assure that a facility can be operated safely in the judgment of NII. Another major difference between the U.S. and the U.K. lies in the fact that the NII is only responsible for operational safety, radiological protection of workers, and emergency planning. The Department of the Environment authorizes discharges, including disposal of radioactive material, and works cooperatively with NII; the Ministry of Agriculture, Fisheries and Food; and other Offices in approving the discharge authorizations. Thus, it is Her Majesty's Inspectorate of Pollution of the Department of the Environment that primarily assesses the environmental impact of a waste disposal site and reviews the performance assessment to provide assurance that the British offsite dose limit of 0.1mSv (10 mrem)/yr will be met. The NII regulates the radiological safety of disposal operations, requires generators to dispose of waste (if a disposal option exists), and ensures pre-planning and preparedness for disposal site incidents, such as a fire. A detailed description of the NII, its implementing legislation, and how it functions can be found in the pamphlet titled "The Work of HM Nuclear Installations Inspectorate," on file in the Division of Low-Level Waste Management and Decommissioning.

The entirety of Monday, November 18, 1991, was spent in discussions with BNFL-Sellafield officials, primarily Les Johnson, Head of BNFL-Sellafield Waste Management Unit, and touring the encapsulation facility, an intermediate-level waste repository borehole, and the Drigg low-level waste disposal facility (see Enclosure 6). The site visit and discussions were preceded by conversations over dinner on November 17, 1991, with Mr.Johnson and Dr. Rex Strong, Head of the BNFL Environment and Personnel (Occupational Safety) which served as an introduction to Sellafield. The paragraphs which follow will outline the national waste disposal program in Great Britain (as described by NII and BNFL) and describe the facilities which were toured.

The high-level waste (HLW) management program in Great Britain is straightforward at this point. Spent reactor fuels (Magnox, Advanced Gas Reactor, and PWR) are, or will be, reprocessed at Sellafield, the HLW vitrified and stored for approximately 50 years. During that 50-year period efforts would be initiated to site and develop a deep geologic repository. No siting work for a deep geologic repository is ongoing at this time or anticipated in the near future.

Intermediate level wastes (ILW), defined as containing greater than 4 GBq/t alpha or 12 GBL/ton beta/gamma and non-heat producing, are currently being stored and will eventually be disposed in the ILW repository after processing into solid form using cement. Currently, swarth (Magnox fuel cladding) ILW is remotely encapsulated in cement at Sellafield in a new facility, Encapsulation Plant 1. Other ILW will be encapsulated in a facility, Encapsulation Plant 2, currently scheduled to begin operation in 1995. After beginning with 39 candidate sites for the ILW repository, all located in the vicinity of nuclear installations, the site selection process is now focussed on the candidate site at Sellafield, Great Britain's largest waste producer. To confirm the geological and hydrogeological information already known or obtained by seismic measurement techniques, a series of approximately 20 deep bore holes will be drilled, extending to a maximum depth of 1900 m and another 60 shallow holes (10's of meter) will also be drilled. We visited deep bore hole #5, currently being drilled and cored using advanced techniques (high rpm drilling, core retrieval without removing the drill stem, dry drilling/coring) adapted from German technology. Deep bore hole #5 will cost approximately 5 million pounds for drilling, coring, and analysis of the cores by the British Geological Society for NIREX, the government body established to manage the development of the ILW repository. However, it appears BNFL will likely be the licensee. It is anticipated that a public inquiry addressing the safety and licensing of the ILW repository will begin in 1993. Conceptually, the repository will be located at a depth of 700 to 900 in a paleozoic age volcanic bedrock. Interestingly, there is a zone lying above the bedrock which consists of heterogeneous-sized clasts that are embedded in clay which is highly impermeable itself and that also does not exhibit any preferential fracture planes that could also serve to transport water. The bedrock formation is essentially free of water; the only water produced to date resulted from the application of extreme differential pressure.

The low-level waste program in Great Britain is in a transitional stage. First, very low-level waste (not clearly defined) can be disposed of at sanitary landfills or other earthen trench facilities if local authorities grant a permit. Specific mention was made of the disposal of U-contaminated soil by this method. Low-level waste generated at Sellafield is currently being disposed in the last of the earthen trenches at the Drigg disposal facility located nearby to Sellafield. The waste may not be containerized and is "tipped" or dumped at the working face of the trench. Caps used over older trenches were not designed to minimize the infiltration of water and a rudimentary leachate collection system exists to collect leachate, permit sampling and monitoring, and automatically discharge to the sea at high tide. Detectable quantities of H-3 are seen in the leachate and in groundwater monitoring wells located in the Drigg site. Vents have been placed in the filled trenches to minimize the possibility of methane gas buildup and to allow gas sampling. The trench disposal operations were similar to the disposal that occurred in the U.S. in the 1960's and early 1970's. However, future trench caps will be designed to minimize the infiltration of water.

LLW from outside Sellafield are required for the most part to be containerized in 500 liter drums which are then stacked in approximately 15 m^3 metal boxes which are in turn tightly stacked in newly constructed concrete vaults to minimize void space between metal boxes. A multiple layer cap, including synthetic membranes, will be placed over the vaults once they are filled. A hard-piped leachate collection system has been installed under the vaults that will allow identification of the vault from which any leachate originated.

Eventually all waste placed in the vaults will be processed (compaction and concrete filling of remaining container void space; or concrete encapsulation into 1 m^3 containers). Three geochemistry instrumentation pods will be located beneath each vault to measure pressure changes, temperature, and pH for example, that will provide information about the degradation of the concrete over time.

BNFL is conducting performance assessment analyses for the Drigg disposal facility using a contractor, Electro-Watt. Much of their work was considered to be company proprietary and could not be shared with us at this time, but not surprisingly, the technical issues in need of resolution are virtually the same as those in the U.S. A few differences in assumptions, however, were apparent. While the British too only assume institutional controls for 100 years, they assume different sets of possible site uses for the period from 100 to 350 years, for the period 350 to 1000 years, and for the period from 1000 years to 10, 000 years. Performance assessments are not conducted for periods in excess of 10,000 years into the future.

In addition to the obvious benefits of meeting counterparts in England, the following programmatic benefits were obtained from the visits and discussions:

- o the success of using mechanical vibration and shaking to uniformly distribute discrete metallic pieces of radioactive waste was demonstrated during the tour of Encapsulation Plant 1 at Sellafield.

- o The borehole work being done by the British to develop the intermediate level waste repository will be a valuable reference for the NRC if mined cavity disposal is selected for use in any of the northeast States in the U.S.

- o The concept of considering different site use scenarios for near term periods after institutional controls are assumed to cease has merit.

- o The British site selection and site operation approach, which in the past has not discouraged rapid groundwater transport and dilution, is in direct opposition to our containment approach. However, if a site which has some of those characteristics, were to be selected by a State, the British experience could be of assistance to NRC.

- o The Magnox swarth encapsulation facility, Encapsulation Plant 1, is a new facility using the latest remote cement encapsulation and radiation protection electronic instrumentation technology. Any future reviews of remote cement encapsulation facilities by NRC would benefit from the sharing of experience by the British.

- o Future visits to England to discuss low-level waste management issues should include a meeting with officials from the Department of the Environment. Enclosure 7 lists the documents that were obtained during the visit to London and Sellafield/Drigg which are readily available in the LLWM files.

Guy A. Arlotto, Deputy Director
Office of Nuclear Material Safety
and Safeguards

Richard L. Bangart, Director
Division of Low-Level Waste Management
and Decommissioning
Office of Nuclear Material Safety
and Safeguards

Paul H. Lohaus, Chief
Low-Level Waste Management Branch
Division of Low-Level Waste Management
and Decommissioning
Office of Nuclear Material Safety
and Safeguards

B. J. Youngblood, Director
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

John J. Linehan, Deputy Director
Division of High-Level Waste Management
Office of Nuclear Material Safety
and Safeguards

Attachments: As stated

DOCUMENT LISTING - FRENCH VISIT

1. ANDRA-A Government Agency for Safe Radioactive Waste Management
2. The "Centre de la Manche"
3. Quality Assurance for Short-Lived Waste Management
4. The Centre de l'Aube Disposal Facility
5. Centre de l'Aube
6. Low-Level Waste Disposal-Safety Approach for the French Center of l'Aube, November 14, 1991

ENCLOSURE 1

MEETING WITH DIRECTION DE LA SURETE DES INSTALLATIONS NUCLEAIRES
AND
U.S. NUCLEAR REGULATORY COMMISSION STAFF

DATE: NOVEMBER 14, 1991

ADDRESS: 60/40 AVENUE DE LA DIVISION LECLERC
FONTENAY-AUX-ROSES
BATIMENT 01

AGENDA:

FRENCH LLW PROGRAM . . . . DSIN — 9:00 a.m.
- National Program for LLW Management
- Regulations, Standards and Licensing Requirements
- Design of LLW Facilities
- Waste Form Processing, Treatment and Storage
- Performance Assessment of LLW Disposal Facilities
- Safety or Regulatory Policy Issues Needing Resolution

BREAK. . . . . 10:30-10:45 a.m.

INTRODUCTION OF NRC LLW AND HLW PROGRAMS . . . 10:45-11:00 a.m.
- Legislation, Organization . . G. Arlotto

U.S. COMMERCIAL LLW PROGRAM . . . . 11:00 a.m.
- Low-Level Radioactive Waste Policy Amendments Act . R. Bangart
- State Progress in Siting. New Facilities and Designs Being Considered . . P. Lohaus
- Regulations, Standards and. Licensing Requirements . R. Bangart
- Waste Form Processing, Treatment and Storage . . . P. Lohaus

LUNCH . . . . 12:15- 1:30 p.m.

U.S. COMMERCIAL HLW PROGRAM. . . . . 1:30 p.m.
- Nuclear Waste Policy Act . . . . B.J. Youngblood
- Regulations . . . . J. Linehan
- Status of DOE Repository Program . . B.J. Youngblood
- NRC Repository-Related Regulatory Activities . . J. Linehan
- Regulatory Guidance. . . . . J. Linehan
- Monitored Retrievable Storage . . . B.J. Youngblood

BREAK . . . . 3:00- 3:15 p.m.

ENCLOSURE 2

FRENCH HLW PROGRAM . . . . 3:15- 4:45 p.m.

- Organization and Responsibilities
- Regulations, Standards and Licensing Requirements for Waste Vitrification and Repository
- Status of Siting and Characterization Activities

CLOSING REMARKS. . . . . 4:45- 5:00 p.m.

DSIN - NRC meeting - Nov, 14, 1991.

Pierre GILLET	COGEMA Industrial Branch - Director of Business Development N. America
Mrs. Nicole TELLIER	International relations coordinator IPSN, DE
Jean HULST	Head of International Relations DSIN
Jean Claude NIEL	Head of Fuel Cycle Division - DSIN
Pierre ESCALIER des ORRES	Deputy Head of Service for safety evaluation of facilities for treatment, interim storage and disposal of wastes, IPSN/DES
Dominique GRENECHE	Head of service for safety evaluation of facilities for treatment, interim storage and disposal of wastes (CEA/IPSN.)
Igor GOLICHEFF	Head of wastes treatment & packaging office (CEA/IPSN/DES/SESID)
Philippe AGALEDES	Safety ~~asses~~ analysis of surface disposals (CEA/IPSN/DES/SESID)
Paul Lohaus	Acting Deputy Director Division of LLW Management + Decommissioning U.S. Nuclear Regulatory Commission
Richard BANGART	Director, Division of Low-Level Waste Management and Decommissioning, U.S. NRC
Guy A. Arlotto	Deputy Director, Office of Nuclear Material Safety and Safeguards
JOHN LINEHAN	DEPUTY DIRECTOR, DIVISION OF HIGH LEVEL WASTE MANAGEMENT
B. J. YOUNGBLOOD	DIRECTOR, DIVISION OF HIGH-LEVEL WASTE MANAGEMENT/ONMSS

INTRODUCTION
LOW-LEVEL WASTE AND
HIGH-LEVEL WASTE PROGRAMS

UNITED STATES NUCLEAR REGULATORY COMMISSION

PRESENTED BY
G.A. ARLOTTO
NOVEMBER 14, 1991

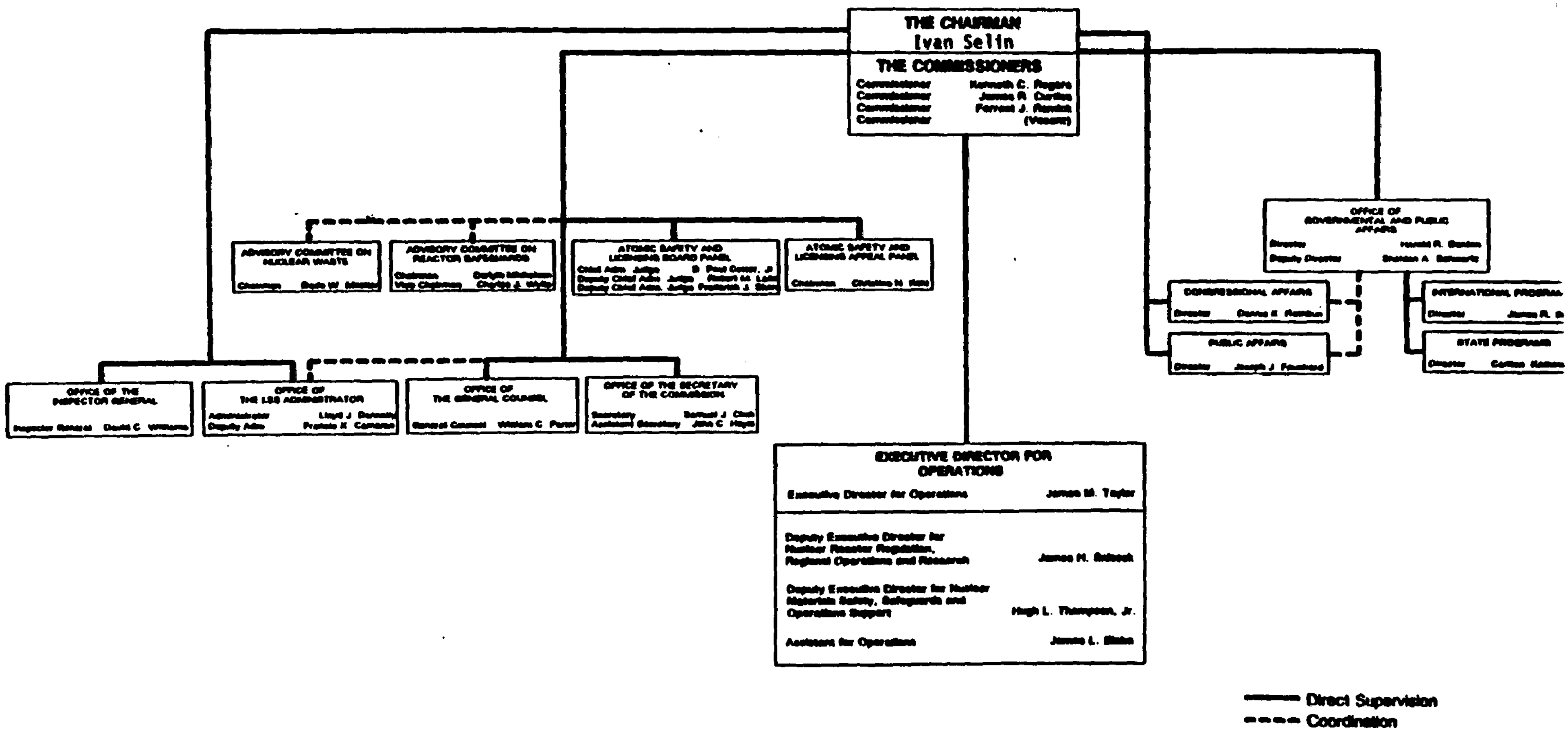
BACKGROUND

LEGISLATION, ORGANIZATIONS AND RESPONSIBILITIES

- ATOMIC ENERGY ACT OF 1954
  - ATOMIC ENERGY COMMISSION
- ENERGY REORGANIZATION ACT OF 1975
  - NUCLEAR REGULATORY COMMISSION
  - DEPARTMENT OF ENERGY
- OTHER FEDERAL AND STATE AGENCIES
  - ENVIRONMENTAL PROTECTION AGENCY
  - AGREEMENT STATES
  - COMPACTS/HOST STATES

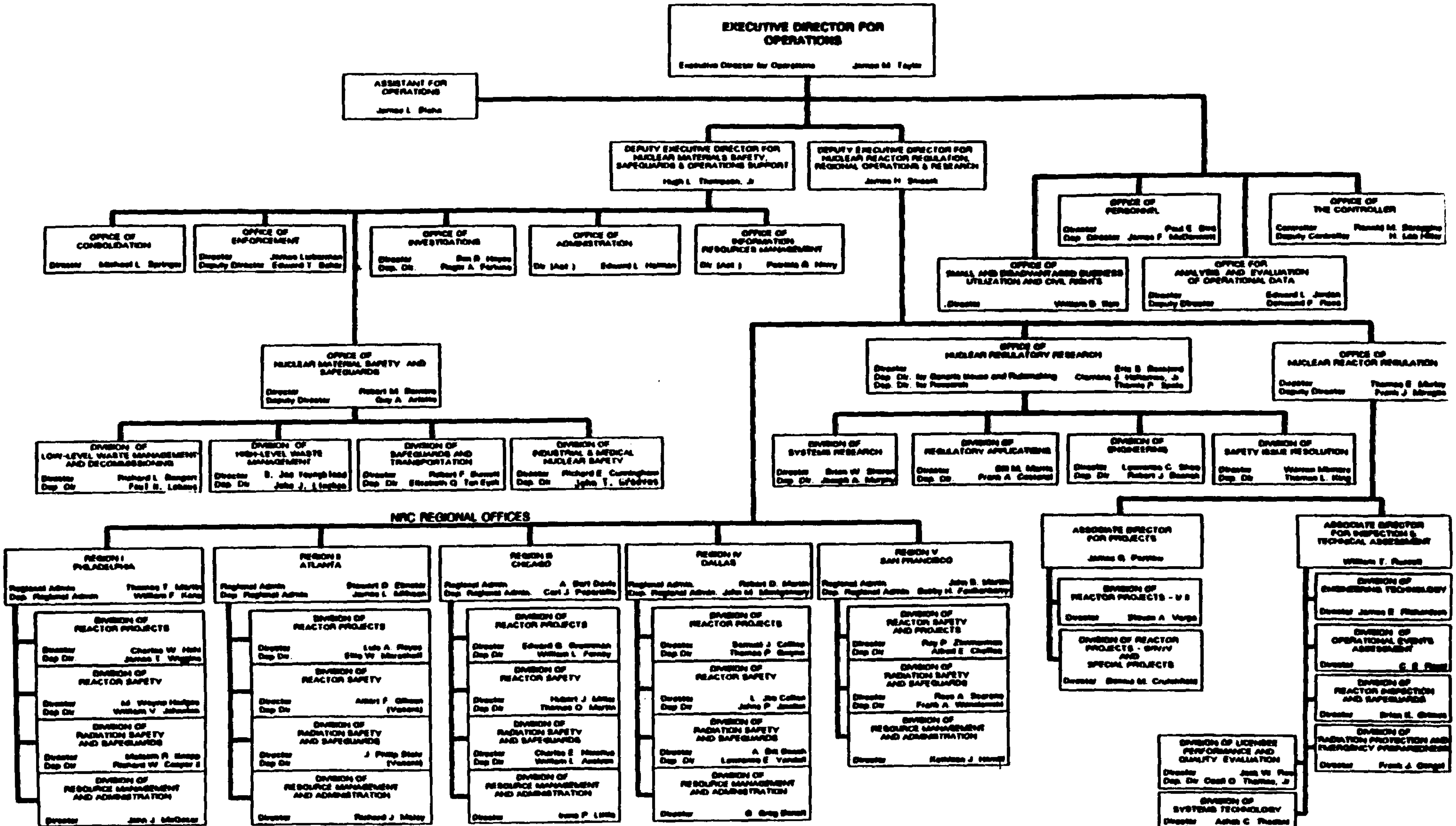
ORGANIZATIONAL CHART

U.S. NUCLEAR REGULATORY COMMISSION



ORGANIZATIONAL CHART

U.S. NUCLEAR REGULATORY COMMISSION



August 15, 1990
Page 2

NRC ORGANIZATION

- DIVISION OF LOW-LEVEL WASTE MANAGEMENT AND DECOMMISSIONING
  - LOW-LEVEL WASTE MANAGEMENT BRANCH
  - URANIUM RECOVERY BRANCH
  - DECOMMISSIONING AND REGULATORY ISSUES BRANCH
- DIVISION OF HIGH-LEVEL WASTE MANAGEMENT
  - REPOSITORY LICENSING AND QUALITY ASSURANCE PROJECT DIRECTORATE
  - GEOLOGY AND ENGINEERING BRANCH
  - HYDROLOGY AND SYSTEMS PERFORMANCE BRANCH
- OFFICE OF RESEARCH
- STATE PROGRAMS
- SPECIFIC IMPLEMENTING LEGISLATION FOR EACH PROGRAM

NRC LOW-LEVEL RADIOACTIVE WASTE PROGRAM

PRESENTED BY
R.L. BANGART
P.H. LOHAUS
NOVEMBER 14, 1991

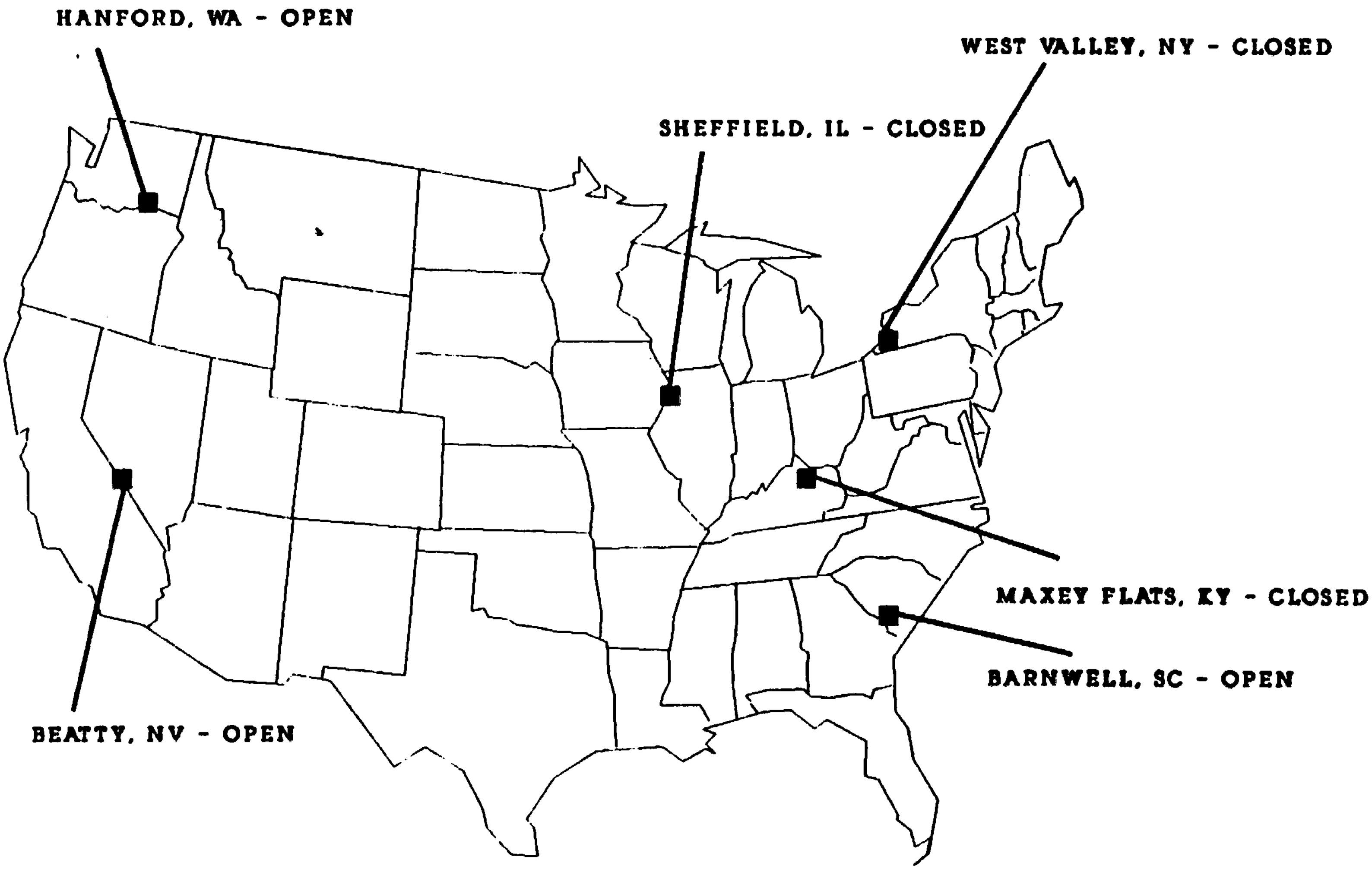
ENCLOSURE 4

REGULATIONS

HISTORICAL PERSPECTIVE

- SIX COMMERCIAL SITES OPERATING IN 1970's
- NO SYSTEMS APPROACH TAKEN
- PROBLEMS DEVELOPED FOR SOME SLB SITES
  - TRENCH SUBSIDENCE
  - FLOODING TRENCHES
  - TRANSPORTATION VIOLATIONS
  - POOR RECORD KEEPING
- THREE SITES CLOSED DUE TO PROBLEMS
- NEW LLW REGULATION - 1982
- LLW POLICY AND AMENDMENTS ACTS - 1980, 1985

LOW-LEVEL WASTE DISPOSAL SITES



LOW-LEVEL RADIOACTIVE WASTE ACT OF 1980

- EACH STATE RESPONSIBLE FOR ITS OWN WASTE
  - EXCEPT DEFENSE WASTES
  - DISPOSAL WITHIN OR OUTSIDE OF STATE

- REGIONAL DISPOSAL: MOST SAFE AND EFFICIENT

- CONGRESS CONSENTS TO COMPACTS

- AFTER JANUARY 1, 1986 COMPACTS MAY RESTRICT USE OF THEIR DISPOSAL FACILITY

POLICY ACT IMPLEMENTATION
(STATUS AS OF 1985)

- NO NEW DISPOSAL SITES BY 1986; SELF SUFFICIENCY BY ALL STATES UNLIKELY BEFORE 1990's

- COMPACT DEVELOPMENT UNCERTAIN IN MAJOR WASTE GENERATION REGIONS

- MAJOR HOST STATES COMMITTED TO LIMITING SITE ACCESS AFTER 1/1/86

- CONGRESS CONSIDERING AMENDMENTS TO POLICY ACT

LOW-LEVEL RADIOACTIVE WASTE POLICY AMENDMENTS ACT OF 1985

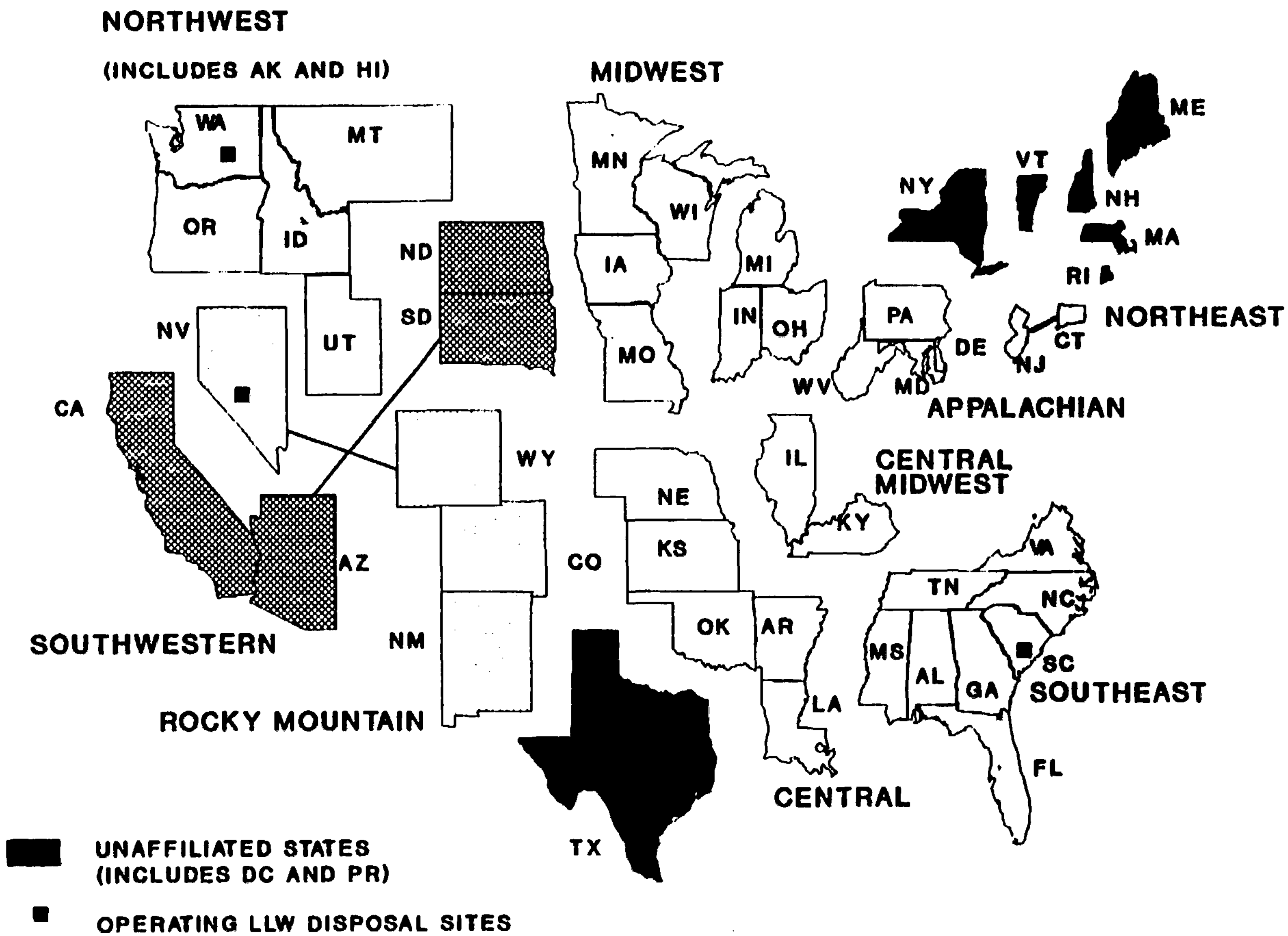
- EACH STATE IS RESPONSIBLE FOR DISPOSAL OF COMMERCIAL CLASS A, B, AND C WASTES
- FEDERAL GOVERNMENT IS RESPONSIBLE FOR GOVERNMENT DEFENSE WASTES AND GREATER THAN CLASS C WASTES
- CURRENTLY OPERATING SITES TO REMAIN OPEN THROUGH 1992
- MILESTONES WITH INCENTIVES AND PENALTIES TO ASSURE STATE PROGRESS IN SITING NEW FACILITIES
- GRANTED CONSENT TO SEVEN INTERSTATE COMPACTS

MILESTONES AND PENALTIES
UNDER LLRWPAA OF 1985

MILESTONES	CALENDAR YEAR	PENALTIES
RATIFY COMPACT LEGISLATION OR GOVERNOR CERTIFIES INTENT TO DEVELOP OWN SITE (5e(1)(A)) →	1986	DOUBLE SURCHARGE 2x$10=$20 (5e(2)(A))
	1987	DENY ACCESS (5e(2)(A))
SITING PLAN (GO-IT-ALONE) OR HOST STATE AND SITING PLAN (COMPACT) (5e(1)(B)) →	1988	DOUBLE SURCHARGE 2x$20=$40 (5e(2)(B)) QUAD SURCHARGE 4x$20=$80 (5e(2)(B))
	1989	DENY ACCESS (5e(2)(B))
LICENSE APPLICATION OR GOVERNOR'S CERTIFICATION TO NRC THAT STATE CAN PROVIDE FOR MANAGEMENT OF LLW AFTER 1992 (5e(1)(C)) →	1990	DENY ACCESS (5e(2)(C))
	1991	
LICENSE APPLICATION (5e(1)(D)) →	1992	TRIPLE SURCHARGE 3x$40=$120 (5e(2)(D))
DISPOSAL SITE OPERATIONAL (5d(2)(c)) →	1993	NO DISPOSAL RIGHTS AFTER 1992
	1994 1995	STATE TAKES TITLE OR FORFEITS SURCHARGE REBATES (5d(2)(c))
DISPOSAL SITE OPERATIONAL (5d(2)(c)) →	1996	STATE TAKES TITLE ↓

LOW-LEVEL RADIOACTIVE WASTE COMPACT STATUS

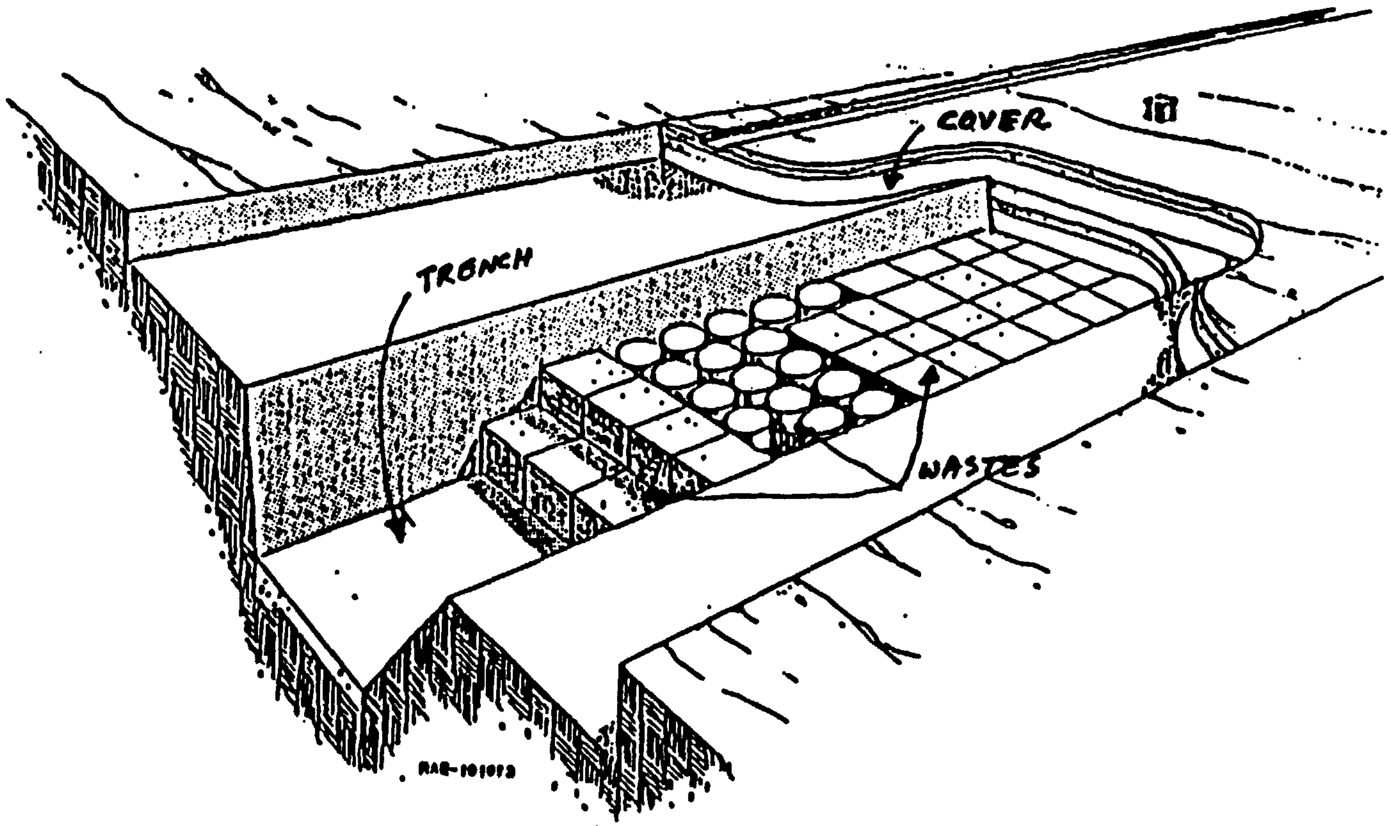
JANUARY 1991



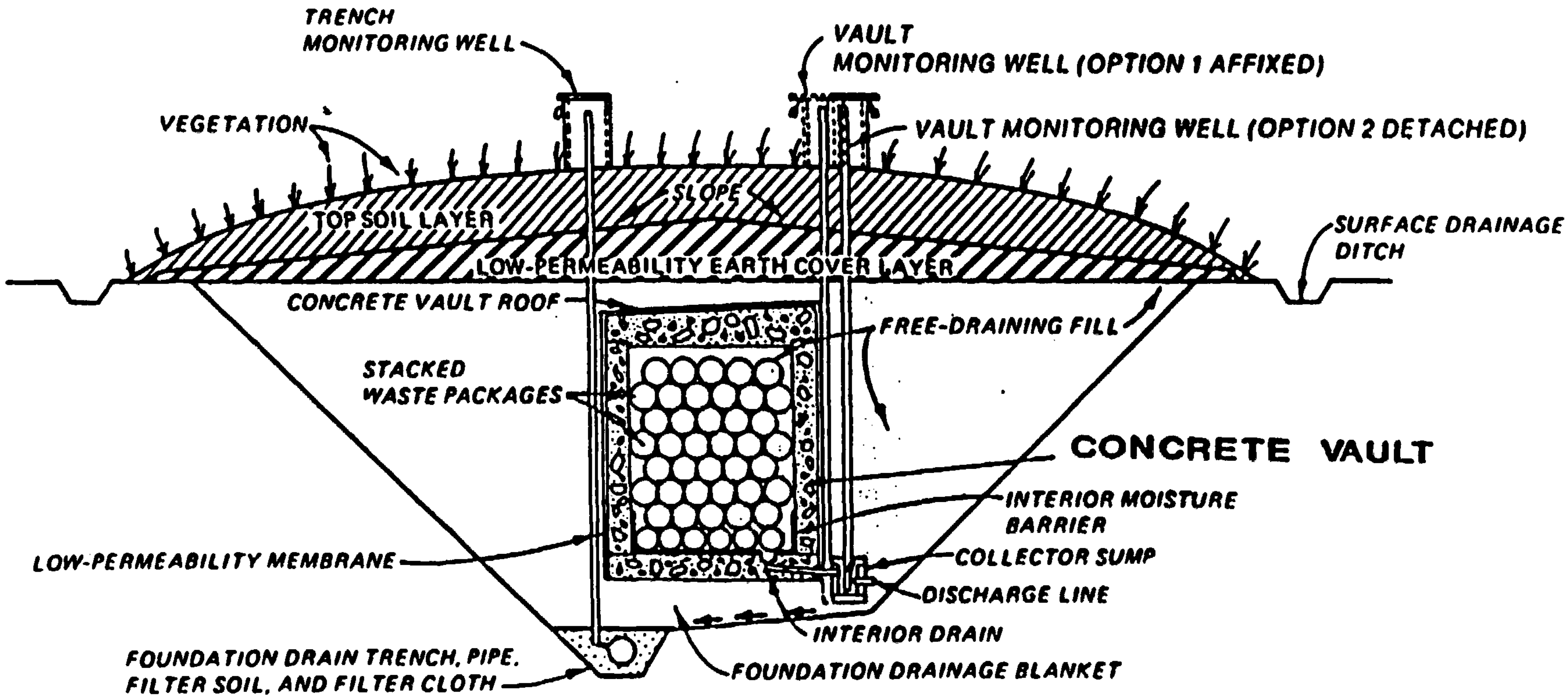
STATUS OF DESIGN SELECTIONS

HOST STATE	OPERATOR	DESIGN
CALIFORNIA	US ECOLOGY	ENHANCED SHALLOW LAND BURIAL
TEXAS	LLRW AUTHORITY	CONCRETE CANISTER BELOW GRADE VAULT
NEBRASKA	US ECOLOGY	ABOVE GRADE COVERED VAULT
ILLINOIS, NORTH CAROLINA & PENNSYLVANIA	CNSI	ABOVE GRADE COVERED VAULT

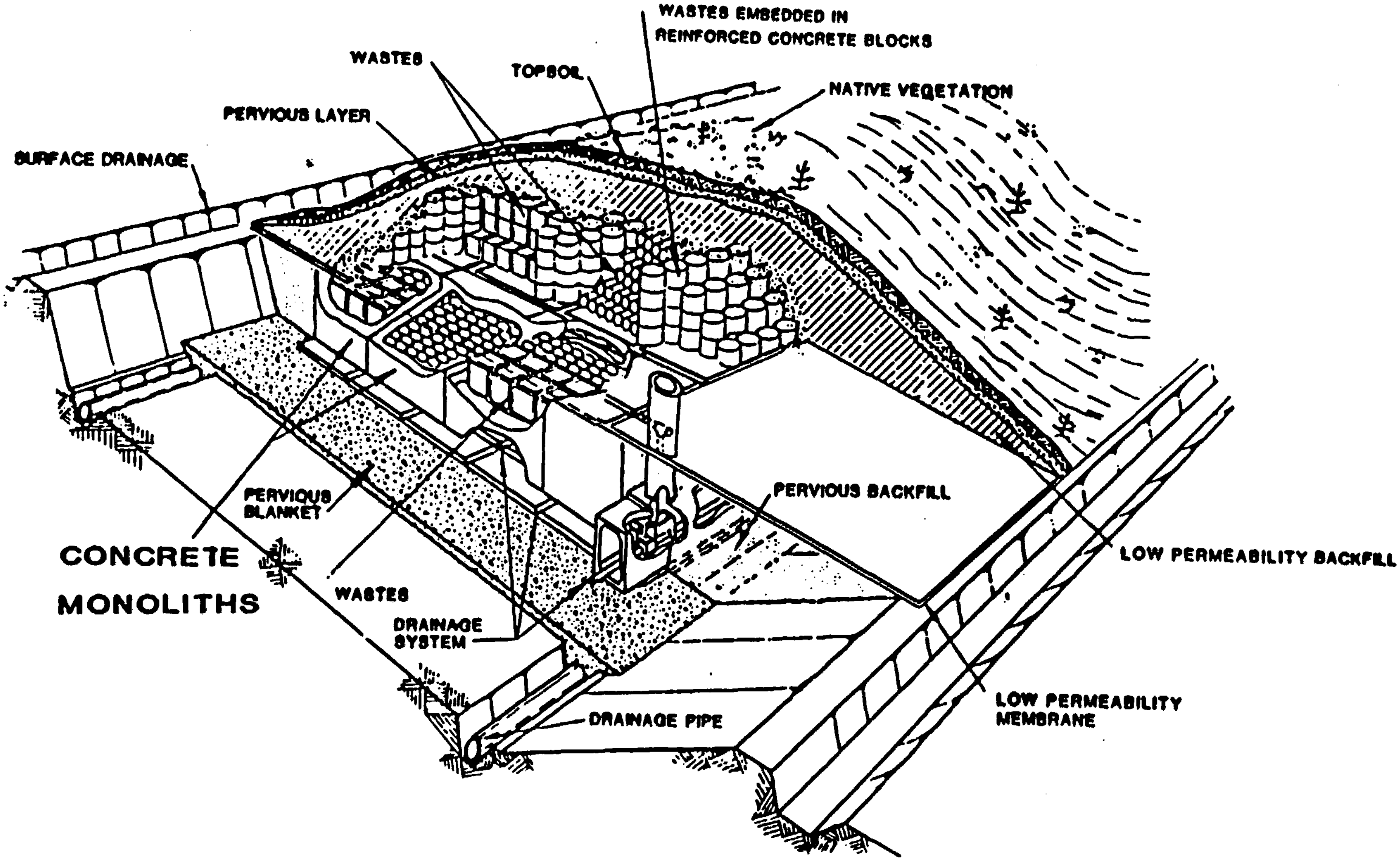
ILLUSTRATION OF A SHALLOW LAND DISPOSAL FACILITY



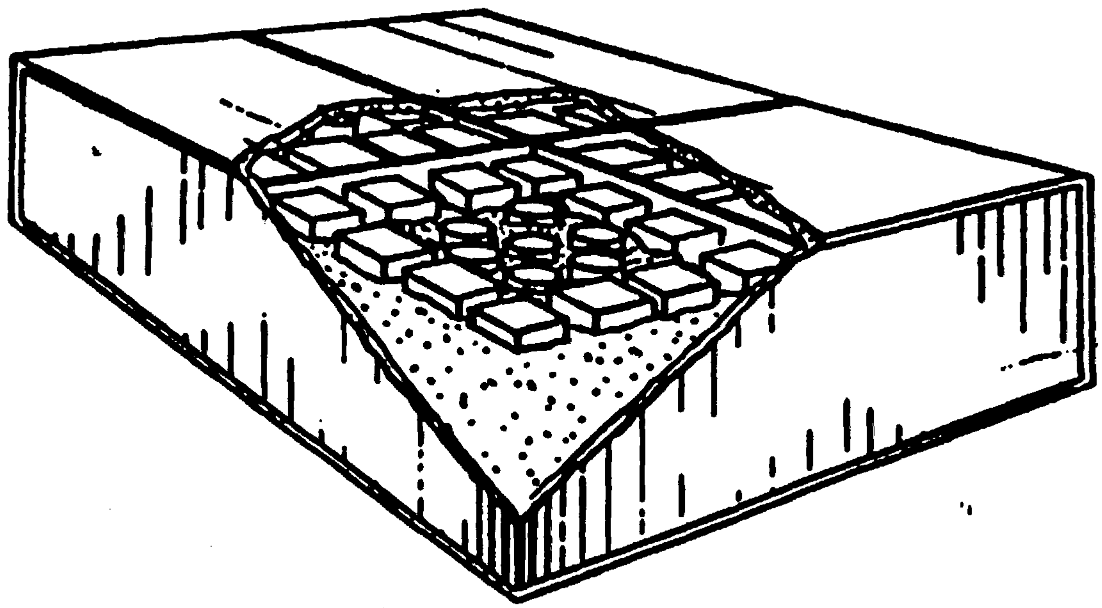
BELOW GROUND VAULT



EARTH MOUNDED CONCRETE BUNKER



CLOSED DISPOSAL UNIT (WITH FOUR MODULES)

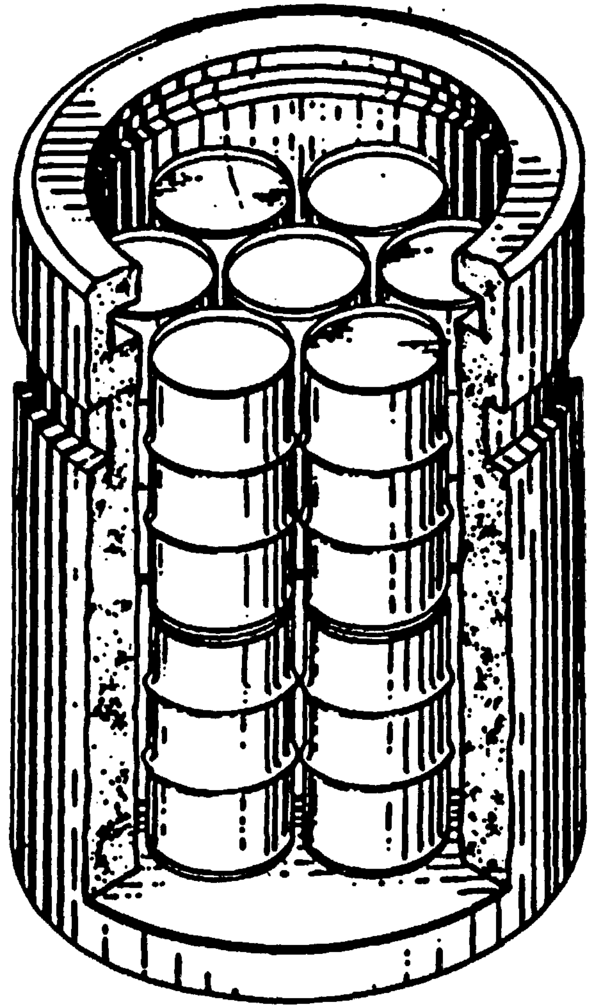


CLOSED DISPOSAL UNIT (WITH FOUR MODULES)

- Filled units will be backfilled with sand and sealed with a concrete roof.

SOURCE: CHEM NUCLEAR SYSTEMS INC.

CYLINDRICAL OVERPACK



CONCRETE OVERPACKS (DRUMS OR CASK LINERS)

- All waste will be placed inside concrete overpacks and sealed with grout.

SOURCE: CHEM NUCLEAR SYSTEMS INC.

10 CFR PART 61 RULEMAKING

10 CFR PART 61

PERFORMANCE OBJECTIVES

TECHNICAL REQUIREMENTS

LICENSING PROCEDURES

10 CFR PART 61
PERFORMANCE OBJECTIVES

- PROTECTION OF THE GENERAL POPULATION FROM RELEASES OF RADIOACTIVITY
- PROTECTION OF INDIVIDUALS FROM INADVERTENT INTRUSION
- PROTECTION OF INDIVIDUALS DURING OPERATIONS
- STABILITY OF THE SITE AFTER CLOSURE

10 CFR PART 61
TECHNICAL REQUIREMENTS FOR NEAR-SURFACE DISPOSAL

- SITE SUITABILITY
- SITE DESIGN, OPERATION AND CLOSURE
- WASTE CLASSIFICATION AND CHARACTERISTICS
- INSTITUTIONAL REQUIREMENTS

10 CFR PART 61
LICENSING PROCESS

▪ PREOPERATIONAL PHASE	4 - 6 YEARS
- SITE SELECTION AND CHARACTERIZATION	3 - 4 YEARS
- LICENSING	$1\frac{1}{4}$ - 2 YEARS
▪ OPERATIONAL PHASE	20 - 40 YEARS
▪ SITE CLOSURE PHASE	1 - 2 YEARS
▪ POST-CLOSURE OBSERVATION AND MAINTENANCE	5 - 15 YEARS
▪ INSTITUTIONAL CONTROL PERIOD	100 YEARS

LLW CLASSIFICATIONS

- CLASS A WASTE
  - USUALLY SEGREGATED
  - MUST MEET MINIMUM WASTE FORM REQUIREMENTS
- CLASS B WASTE
  - RIGOROUS WASTE FORM REQUIREMENTS
- CLASS C WASTE
  - RIGOROUS WASTE FORM REQUIREMENTS AND PROTECTION AGAINST INADVERTENT INTRUSION

GREATER THAN CLASS C (GTCC) WASTE

NOT GENERALLY ACCEPTABLE FOR NEAR-SURFACE DISPOSAL

DISPOSAL IN GEOLOGIC REPOSITORY UNLESS COMMISSION APPROVES DISPOSAL UNDER PART 61

REGULATORY GUIDANCE
ON
LOW-LEVEL WASTE FORM STABILITY

UNITED STATES NUCLEAR REGULATORY COMMISSION

PART 61 REQUIREMENTS

61.55 WASTE CLASSIFICATION

61.56 WASTE CHARACTERISTICS

CLASS A	Meet minimum requirements - usually segregated
CLASS B & C	Must have structural stability; generally maintain its physical dimensions and form for 300 years.

Stability can be provided by

(1) waste form (e.g. activated metal)

(2) processing to a stable form (e.g. solidification)

(3) disposal container (e.g. HIC),

or (4) structure (e.g. engineered alternatives)

TECHNICAL POSITION ON WASTE FORM

- Provides guidance on how to meet the Part 61 structural stability requirements.

- Lists methods of test and acceptance criteria.

- Short term tests are used as indicators of long-term structural stability.

SOLIDIFIED PRODUCT GUIDANCE

TEST	METHOD	ACCEPTANCE CRITERION
1. COMPRESSIVE STRENGTH	ASTM C39 OR ASTM D1074 AND ADEQUATE BACKFILL (BITUMEN)	414 kPa
2. RADIATION STABILITY		414 kPa AFTER 10E6 Gy
3. BIODEGRADATION	ASTM G21 AND G22	NO GROWTH AND 414 kPa
4. LEACHABILITY	ANS 16.1	LIX OF 6
5. IMMERSION		414 kPa AFTER 90 DAYS
6. THERMAL CYCLING	ASTM B553	414 kPa AFTER 30 CYCLES FROM -40°C TO 60°C
7. FREE LIQUID	ANS 55.1	0.5 PERCENT
8. FULL-SCALE TESTS		HOMOGENEOUS AND CORRELATES TO LAB SIZE TEST RESULTS

CEMENT

List of Events Indicating Problems at Power Reactors

- TMI — Expansion and degradation of solidified EPICOR bead resins in liner
- Millstone — Expansion of solidified LOMI decontamination resin in liner
- Fitzpatrick — Partially unsolidified bead resin/ picolinic acid in liner
- Quad Cities — Premature setting of LOMI decontamination resin in liner

NUREG/CP-0103
NISTIR 89-4178

Proceedings of the

Workshop on Cement Stabilization of Low-Level Radioactive Waste

Held at
Gaithersburg Marriott Hotel
Gaithersburg, Maryland
May 31 - June 2, 1989

Sponsored by
Office of Nuclear Regulatory Research
Office of Nuclear Material Safety and Safeguards
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission

and

Building Materials Division
National Institute of Standards and Technology

Proceedings prepared by
U.S. Nuclear Regulatory Commission

United States Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Washington, D.C. 20555

TECHNICAL POSITION

ON

WASTE FORM

(Revision 1)

Prepared by: Low-Level Waste Management Branch
Division of Low-Level Waste Management
and Decommissioning

January 1991

TABLE OF CONTENTS

Technical Position on Waste Form

Appendix A - Cement Stabilization

WASTE FORM QUALIFICATION TESTING

Major Change: Increase in minimum compressive strength to 500 psi.

SURVEILLANCE SPECIMENS

- For "Problem Waste" streams
  - Bead Resins
  - Chelates
  - Filter Sludge
  - Floor Drain Materials

- Compressive strength measurements at 6 and 12 months

- Immersion test at 12 months, followed by compressive strength test.

SUMMARY

- New guidance on cement-solidified LLW contained in Technical Position on Waste Form

- Most significant changes include:
  - Increase in compressive strength criterion
  - Surveillance of problem wastes

- Topical Reports being reviewed are receiving interim (12-month) approvals

Table I

LIST OF WASTE CONSTITUENTS THAT MAY CAUSE PROBLEMS WITH CEMENT SOLIDIFICATION

POTENTIAL PROBLEM CONSTITUENTS WHICH MAY BE EXPECTED IN THE WASTE STREAM

Inorganic Constituents

- Borates [1]
- Phosphates [1]
- Lead salts [2]
- Zinc salts
- Ammonia and ammonium salts
- Ferric salts
- "Oxidizing agents" [1] (often proprietary)
  - Permanganates [1]
  - Chromates [2]
- Nitrates [1]
- Sulfates [1]

Organic Constituents - Aqueous Solutions

- Organic acids [1]
  - Formic acid (and formates)
- "Chelates" [1],[3]
  - Oxalic acid (and oxalates)
  - Citric acid (and citrates)
  - Picolinic acid (and picolinates)
  - EDTA (and its salts)
  - NTA (and its salts)
- "Decon solutions"[1]
  - Soaps and detergents [1].

Organic Constituents - Oily Wastes

- Benzene [1],[2]
- Toluene [1],[2]
- Hexane [1]
- Miscellaneous hydrocarbons.
- Vegetable oil additives

POTENTIAL PROBLEM CONSTITUENTS THAT MAY BE AVOIDED BY HOUSEKEEPING OR PRETREATMENT [4]

Generic Problem Constituents [5]

- Oil [1] and grease
- "Aromatic oils" [1]
- "Organic solvents" [1],[2]
  - Dry-cleaning solvents [1],[2]
- "Industrial cleaners" [1],[2]
  - Paint thinners [1],[2]
- "Decon solutions" [1]
  - Soaps and detergents [1]

Specific Problem Constituents - Organic

- Acetone [1],[2]
- Methyl ethyl ketone [2]
- Trichloroethane [2]
- Trichlorotrifluoroethane [2]
- Xylene [2]
- Dichlorobenzene [2]

Specific Problem Constituents - Inorganic

- Sodium hypochlorite [1]

NOTES:

[1] These constituents have been specifically identified by vendors as having the potential to cause problems with cement solidification of low-level wastes.

[2] The presence of these constituents may result in the generation of mixed wastes. The Environmental Protection Agency should be contacted for more information.

[3] All of these chelating agents could also be identified as "organic acids."

[4] Good housekeeping and pretreatment could also be effective in preventing problems with cement solidification for many of the constituents listed in the top list.

[5] These specific constituents also fall into several of the "generic" problem constituents "categories" listed at the left.

TOPICAL REPORT REVIEW STATUS SUMMARY
SOLIDIFIED WASTE FORMS AND HIGH INTEGRITY CONTAINERS (HIC's)

Office of Nuclear Material Safety and Safeguards

October 1, 1991

VENDOR	DOCKET NO	TOPICAL REPORT	DISPOSITION
Nuclear Packaging	WM-45	HIC (Ferralium/FL-50)	APPROVED
SEG	WM-46	Solidification (Cement)	APPROVED*
Chichibu	WM-81 Rev 2.1	HIC (Concrete/Poly)	APPROVED
DOW Chemical	WM-82	Solidification (Polymer)	APPROVED
Nuclear Packaging	WM-85	HIC (Ferralium/Enviralloy)	APPROVED
General Electric	WM-88	Solidification (Polymer)	APPROVED
WasteChem	WM-90	Solidification (Bitumen)	APPROVED
LN Technologies	WM-93 Rev 1	HIC (Stainless/Poly)	APPROVED
Chem-Nuclear	WM-97 Rev 1	Solidification (Cement #2)	APPROVED**
Chem-Nuclear	WM-98	Solidification (Cement #3)	APPROVED**
Chem-Nuclear	WM-101	Solidification (Cement #1)	APPROVED**
U.S. Ecology	WM-102	Solidification (Bitumen)	APPROVED***
Chem-Nuclear	WM-18	HIC (HDPE)	NOT APPROVED
Pacific Nuclear	WM-51	Solid (Envirostone)	NOT APPROVED
TFC Nuclear	WM-76	HIC (HDPE)	NOT APPROVED
Westinghouse	WM-80	HIC (HDPE)	NOT APPROVED
VIKEM	WM-13	Solid (Oil/Cement)	DISCONTINUED
U.S. Ecology	WM-91	Solidification (Bitumen)	DISCONTINUED
Stock	WM-92	Solidification (Cement)	DISCONTINUED
U.S. Ecology	WM-100	Solid (NS1 Bitumen)	DISCONTINUED
Chem-Nuclear	WM-19	Solidification (Cement)	WITHDRAWN
Chem-Nuclear	WM-47	HIC (Fiberglass/Poly)	WITHDRAWN
LN Technologies	WM-57	HIC (HDPE)	WITHDRAWN
Nuclear Packaging	WM-71	Solid/Encap (Cement/Gypsum)	WITHDRAWN
Westinghouse	WM-79	Solidification (SG-95)	WITHDRAWN
Nuclear Packaging	WM-87	HIC (Stainless/SDS)	WITHDRAWN
Bondico	WM-94	HIC (Fiberglass/Poly)	WITHDRAWN
Chem-Nuclear	WM-96	Solidification (Cement)	WITHDRAWN
SEG (LN Tech)	WM-20	Solidification (Cement)	UNDER REVIEW
Avancer (B&W)	WM-95	HIC (Coated Carbon Steel)	UNDER REVIEW
SEG (LN Tech)	WM-99	Solid (Cement/Decon)	UNDER REVIEW
Pacific Nuclear	WM-103	HIC (Enviroglass)	UNDER REVIEW
JGC Corp.	WM-104	Solidification (Cement)	UNDER REVIEW
Diversified Tech.	WM-105	Solidification (VERI)	UNDER REVIEW

* Interim (1-year) approval granted for selected waste forms on September 30, 1991.

** Interim (1-year) approval granted for selected waste forms on July 2, 1991.

*** Interim (1-year) approval granted for one waste formulation on August 2, 1991.

LLW STORAGE

- GENERIC LETTER 81-38
- GENERIC LETTER 85-14
- INFORMATION NOTICE 89-13
- INFORMATION NOTICE 90-09

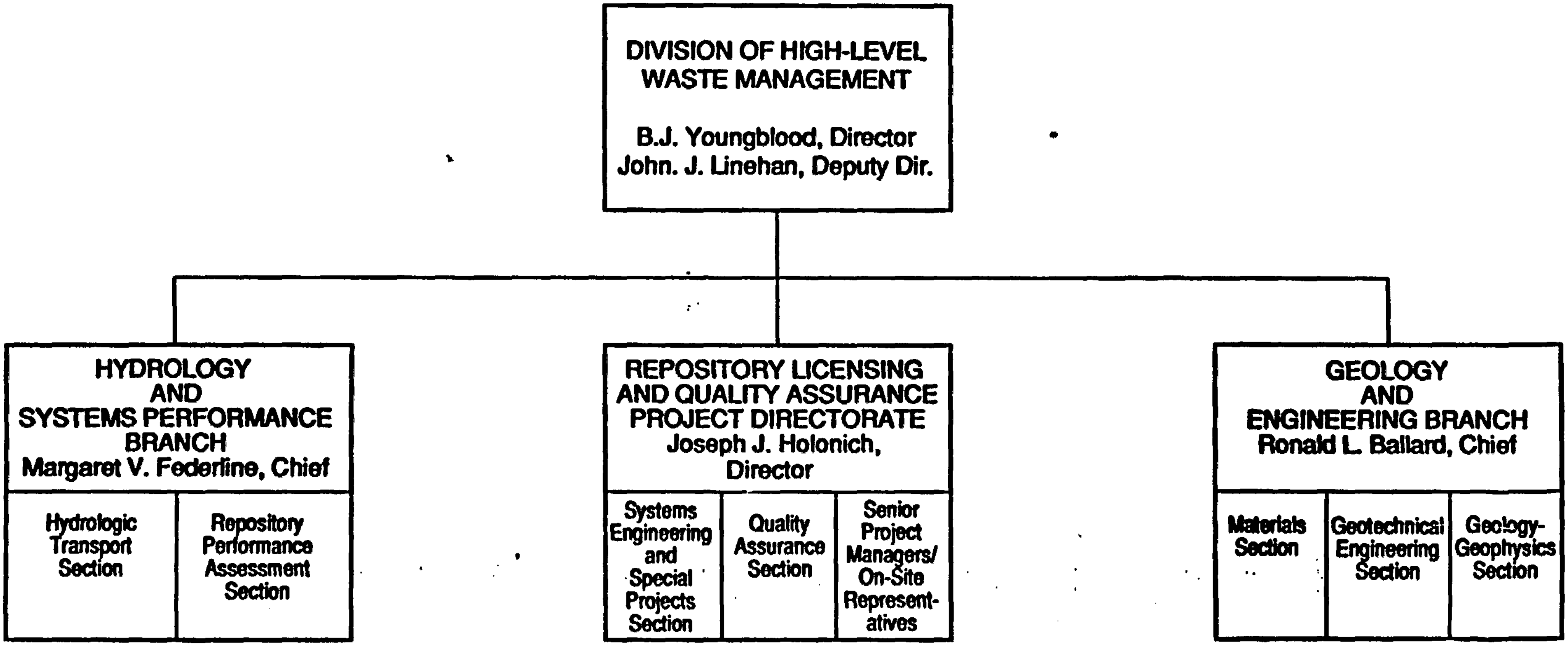
NRC HIGH-LEVEL RADIOACTIVE WASTE PROGRAM

UNITED STATES NUCLEAR REGULATORY COMMISSION

Presented by
B.J. Youngblood and John J. Linehan
November 14, 1991

ENCLOSURE 5

DIVISION OF HIGH-LEVEL WASTE MANAGEMENT ORGANIZATIONAL STRUCTURE



NUCLEAR WASTE POLICY ACT

NUCLEAR WASTE POLICY ACT (NWPA) - 1982

- U.S. DEPARTMENT OF ENERGY (DOE) RESPONSIBLE FOR SITING, DEVELOPMENT, AND OPERATIONS OF GEOLOGIC REPOSITORIES FOR THE DISPOSAL OF RADIOACTIVE HIGH-LEVEL WASTE (HLW)
- DOE REQUIRED TO TAKE OWNERSHIP OF SPENT FUEL BY 1998
- CHARACTERIZATION OF POTENTIAL SITES IN SEVERAL ROCK MEDIA
- SET 70,000 METRIC TON LIMIT FOR REPOSITORY
- SECOND REPOSITORY TO BE IN CRYSTALLINE ROCK

NUCLEAR WASTE POLICY ACT (NWPA) - 1982 (CONT'D)

- ESTABLISHED NUCLEAR WASTE FUND TO FINANCE REPOSITORY PROGRAM
- U.S. NUCLEAR REGULATORY COMMISSION (NRC) RESPONSIBLE FOR LICENSING GEOLOGIC REPOSITORY AND MONITORED RETRIEVABLE STORAGE (MRS) FACILITY
- NRC MUST MAKE LICENSING DECISION FOR REPOSITORY WITHIN 3 YEARS
- U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) TO PROMULGATE ENVIRONMENTAL STANDARDS
- CALLED FOR DEVELOPMENT OF MRS
- SPECIFIED UNIQUE ROLE OF STATES AND INDIAN TRIBES IN THE PROCESS

NUCLEAR WASTE POLICY AMENDMENTS ACT (NWPAA) - 1987

- CALLED FOR CHARACTERIZATION OF ONLY ONE SITE - YUCCA MOUNTAIN, NEVADA
- REQUIRES DOE TO REPORT TO U.S. CONGRESS BETWEEN THE YEARS OF 2007 AND 2010 ON NEED FOR A SECOND REPOSITORY
- MRS PLACED ON SCHEDULE COUPLED WITH REPOSITORY SCHEDULE
- ESTABLISHED NUCLEAR WASTE NEGOTIATOR TO INDEPENDENTLY ATTEMPT TO FIND STATE OR INDIAN TRIBE WILLING TO HOST REPOSITORY OR MRS
- ESTABLISHED NUCLEAR WASTE TECHNICAL REVIEW BOARD TO PROVIDE OVERSIGHT TO DOE PROGRAM

REGULATIONS

CONTROLLING REGULATIONS - HLW

- 10 CFR 960 - DOE

  -- SITE SELECTION AND DEVELOPMENT

- 40 CFR 191 - EPA

  -- DISPOSAL CRITERIA FOR TRANSURANIC WASTE AND HLW
  -- REMANDED BY COURT

- 10 CFR 60 - NRC

  -- LICENSING HLW DISPOSAL
  -- GENERAL REQUIREMENTS
  -- SUBSYSTEM PERFORMANCE REQUIREMENTS
  -- MEET 40 CFR 191 CONTAINMENT REQUIREMENTS

10 CFR PART 960 - DOE SITING GUIDELINES

- DOE REGULATION FOR GEOLOGIC REPOSITORY SITE SELECTION

- REQUIRED BY NWPA

- DEVELOPED BY DOE IN 1984
  - -- CONSULTATION WITH STATES AND OTHER FEDERAL AGENCIES
  - -- NRC CONCURRENCE
  - -- PUBLIC COMMENT

- IMPLEMENTATION GUIDELINES
  - -- GOVERN IMPLEMENTATION OF DOE SITE-SELECTION PROCESS
  - -- GOVERN USE OF TECHNICAL GUIDELINES IN EVALUATING SITES

- TECHNICAL GUIDELINES FOR PRE- AND POST-CLOSURE

40 CFR 191 - EPA STANDARD

- CONTAINMENT REQUIREMENT

    -- RELEASES MORE LIKELY THAN 1/10 IN 10,000 YEARS MAY NOT EXCEED SPECIFIED LIMITS

    -- RELEASES MORE LIKELY THAN 1/1000 BUT LESS LIKELY THAN 1/10 IN 10,000 YEARS MAY NOT EXCEED 10 TIMES THE SPECIFIED LIMITS

- INDIVIDUAL PROTECTION REQUIREMENT

    -- LIMITS DOSE TO INDIVIDUALS

- GROUNDWATER PROTECTION REQUIREMENT

    -- LIMITS RADIONUCLIDE CONCENTRATIONS IN SPECIAL SOURCES OF GROUNDWATER

10 CFR PART 60
NRC REGULATION FOR LICENSING GEOLOGIC REPOSITORIES

- PROCEDURAL REQUIREMENTS
  - -- PRE-APPLICATION REVIEWS
  - -- LICENSES
  - -- PARTICIPATION BY STATES AND AFFECTED INDIAN TRIBES

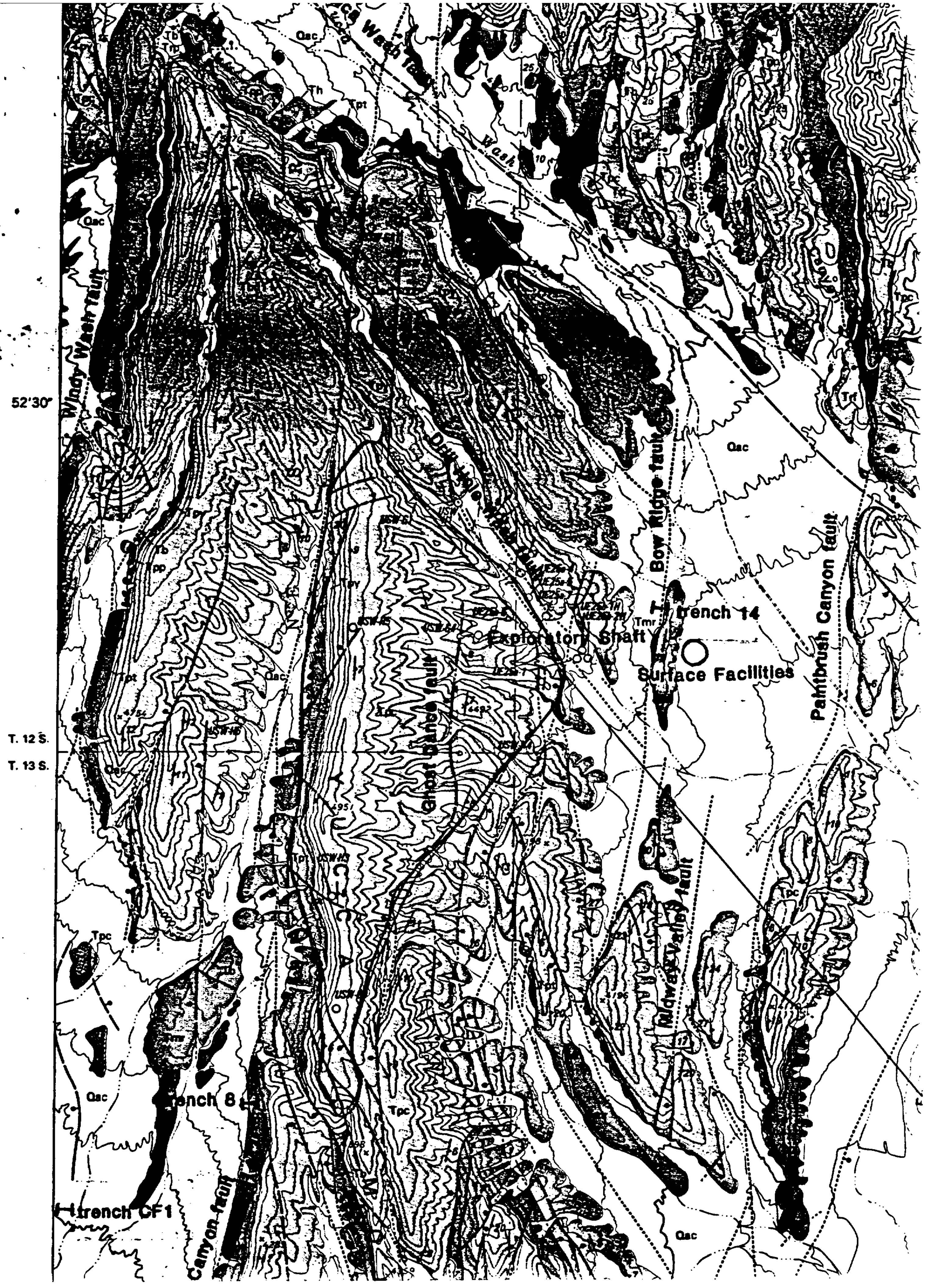
- TECHNICAL CRITERIA
  - -- PRECLOSURE AND POSTCLOSURE
  - -- MULTIPLE BARRIER APPROACH
  - -- NUMERICAL PERFORMANCE OBJECTIVES
    - * OVERALL SYSTEM--EPA STANDARD
    - * ENGINEERED BARRIER--WASTE PACKAGE LIFETIME
      - - ENGINEERED BARRIER SYSTEM RELEASE
    - * NATURAL SYSTEM--MINIMUM GROUNDWATER TRAVEL TIME
  - -- QUALITATIVE SITING AND DESIGN CRITERIA

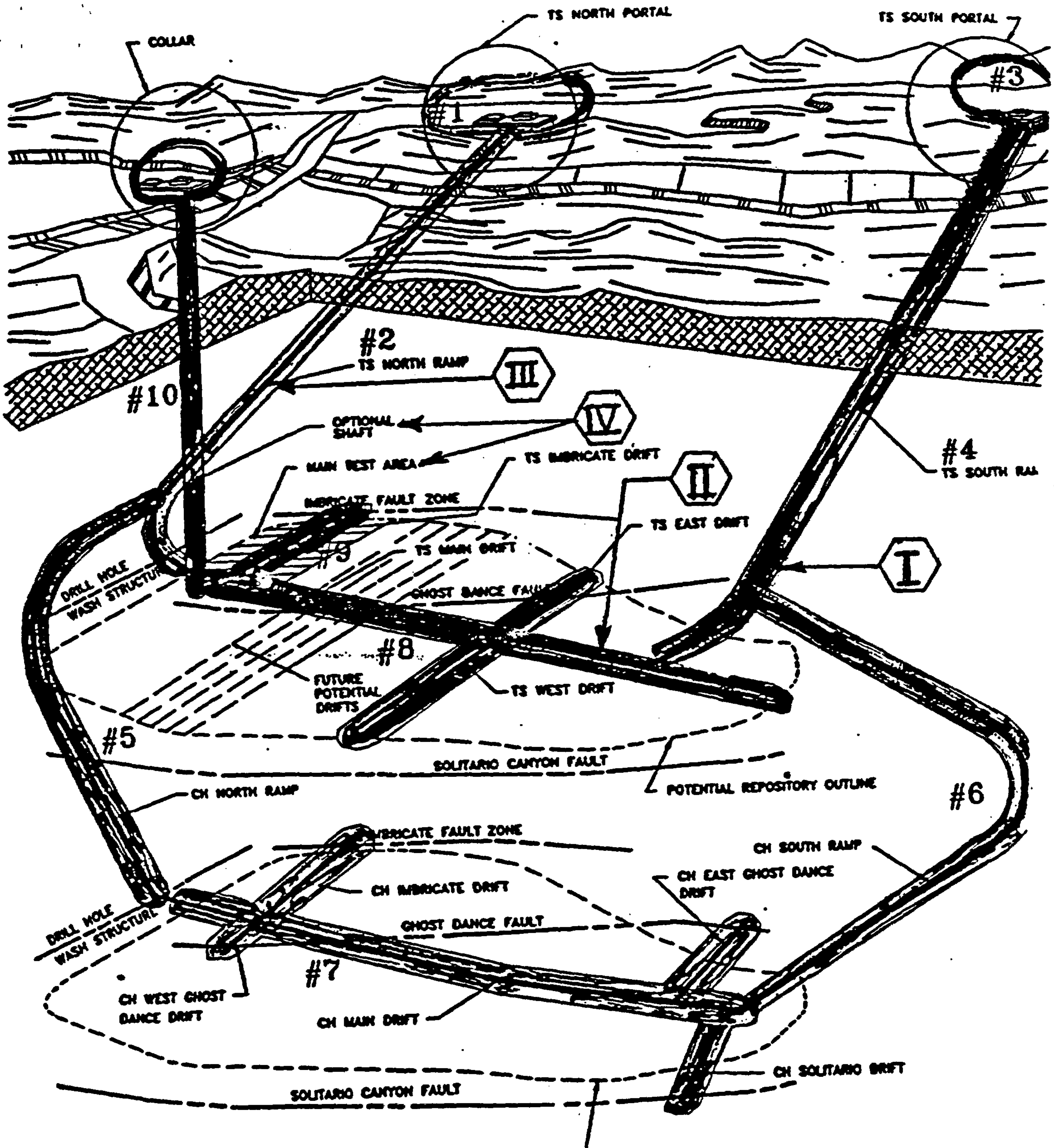
STATUS OF DOE REPOSITORY PROGRAM

REPOSITORY PROGRAM MILESTONES

12/88	DOE ISSUES SITE CHARACTERIZATION PLAN
01/92	DOE BEGINS NEW SURFACE-BASED TESTING
11/92	DOE BEGINS LIMITED EXPLORATORY STUDIES FACILITY (ESF) CONSTRUCTION
01/98	DOE ACCEPTS WASTE
04/01	DOE ISSUES SITE RECOMMENDATION REPORT TO PRESIDENT
10/01	DOE SUBMITS LICENSE APPLICATION TO NRC
10/04	NRC DECISION ON CONSTRUCTION AUTHORIZATION
10/04	DOE BEGINS REPOSITORY CONSTRUCTION
10/10	DOE BEGINS WASTE EMPLACEMENT

YUCCA MOUNTAIN





NOTE: THIS IS PICTORIAL ONLY AND NOT DRAWN TO SCALE

ESF TITLE II PROPOSED CONSTRUCTION PHASES

NRC REPOSITORY-RELATED REGULATORY ACTIVITIES

DIVISION OF HIGH-LEVEL WASTE MANAGEMENT (DHLWM)
OVERALL PROGRAM

- REACTIVE PROGRAM
  - -- QUALITY ASSURANCE
  - -- PRE-LICENSING AND SITE CHARACTERIZATION REVIEWS
- PROACTIVE PROGRAM
  - -- REGULATORY REQUIREMENTS AND TECHNICAL GUIDANCE
  - -- TECHNICAL ASSESSMENT CAPABILITY
  - -- SYSTEMATIC REGULATORY ANALYSIS AND CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES (CNWRA)

NRC HLW REACTIVE PROGRAM

THE PURPOSE OF THE REACTIVE PROGRAM IS THE EARLY IDENTIFICATION AND RESOLUTION OF POTENTIAL LICENSING ISSUES.

- PRE-LICENSING AND SITE CHARACTERIZATION REVIEWS
  - -- PERFORM EVALUATIONS OF DOE DOCUMENTS
  - -- CONDUCT ON-SITE REVIEWS OF DOE PROGRAMS
  - -- HAVE TECHNICAL INTERACTIONS WITH DOE
- QUALITY ASSURANCE
  - -- PERFORM EVALUATIONS OF DOE AND DOE CONTRACTOR QA DOCUMENTS AND QA ASPECTS OF DOE AND DOE CONTRACTOR TECHNICAL DOCUMENTS
  - -- EVALUATE THE IMPLEMENTATION OF DOE QA PROGRAM (I.E., AUDITS AND READINESS REVIEWS)

PROACTIVE PROGRAM

REGLATORY REQUIREMENTS AND TECHNICAL GUIDANCE

TECHNICAL ASSESSMENT CAPABILITY

SYSTEMATIC REGULATORY ANALYSIS AND CNWRA

REGULATORY REQUIREMENTS AND TECHNICAL GUIDANCE

- RULES AND AMENDMENTS
- FORMAT AND CONTENT REGULATORY GUIDE
- STAFF POSITIONS/TECHNICAL POSITIONS

TECHNICAL ASSESSMENT CAPABILITY

- REVIEW PLAN PREPARATION
- ANALYSIS METHOD PREPARATION
- ITERATIVE PERFORMANCE ASSESSMENT

SYSTEMATIC REGULATORY ANALYSIS

- DISCIPLINED AND DOCUMENTED PROCESS FOR SYSTEMATICALLY AND COMPREHENSIVELY ANALYZING 10 CFR PART 60 TO IDENTIFY AND CONDUCT APPROPRIATE STAFF WORK NEEDED TO SUPPORT LICENSING ACTIVITIES

- DEFINES FRAMEWORK IN WHICH TECHNICAL WORK IS CONDUCTED AND DOCUMENTED

- SUPPORTS AND UTILIZES THE TECHNICAL JUDGMENT OF THE NRC STAFF

SYSTEMATIC REGULATORY ANALYSIS (CONT'D)

- SRA DEFINES NUMEROUS ANALYSES OF 10 CFR PART 60
  - -- IDENTIFY WHERE 10 CFR PART 60 IS UNCLEAR OR INCOMPLETE
  - -- IDENTIFY TECHNICAL QUESTIONS ABOUT HOW TO DEMONSTRATE COMPLIANCE WITH 10 CFR 60
  - -- IDENTIFY INFORMATION NEEDED IN THE LICENSE APPLICATION
  - -- DEVELOP METHODS AND CRITERIA FOR LICENSE APPLICATION REVIEW

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

- THE CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES (CNWRA) IS A FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTER

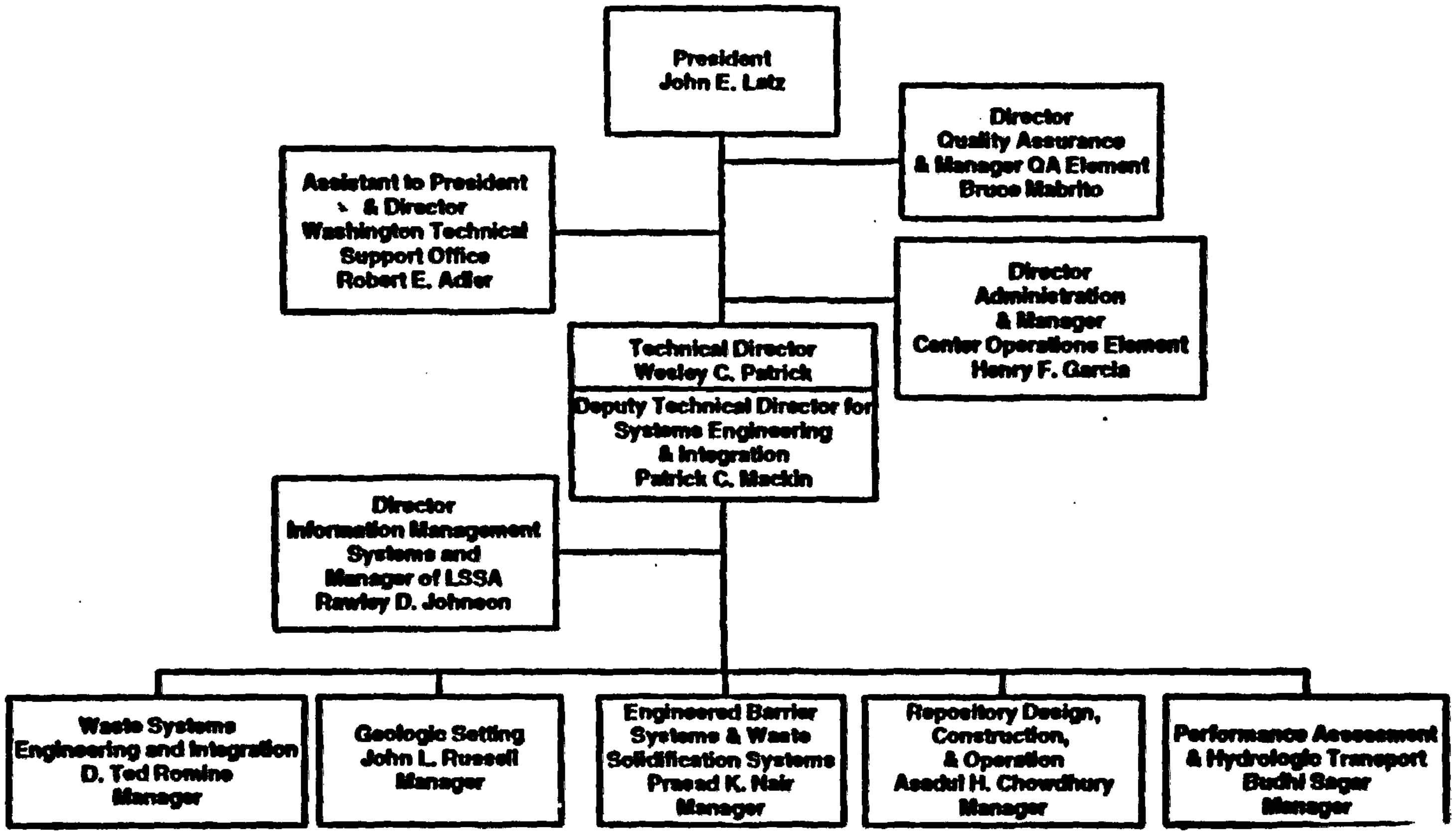
- THE NRC ESTABLISHED THE CNWRA:

  - TO PRECLUDE CONTRACTOR CONFLICT OF INTEREST, AND

  - TO ASSURE LONG TERM CONTINUITY OF CONTRACTED RESEARCH

- THE CNWRA IS AN AUTONOMOUS UNIT OF THE SOUTHWEST RESEARCH INSTITUTE LOCATED IN SAN ANTONIO, TX

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES



EXAMPLES OF REGULATORY GUIDANCE

FORMAT AND CONTENT OF THE LICENSE APPLICATION FOR THE HIGH-LEVEL WASTE REPOSITORY (FCRG)

- THE FCRG IS BEING DEVELOPED TO INDICATE THE INFORMATION TO BE PROVIDED IN THE LICENSE APPLICATION FOR THE HLW REPOSITORY AND TO ESTABLISH AN ACCEPTABLE FORMAT

- THE FCRG FOLLOWS A REPOSITORY SYSTEMS-BASED FORMAT THAT REFLECTS THE WAY THE REPOSITORY SYSTEM IS DEFINED IN THE REGULATIONS

- THE FCRG WAS ISSUED AS A DRAFT DOCUMENT TO RECEIVE COMMENTS FROM DOE AND OTHER INTERESTED PARTIES

FORMAT AND CONTENT OF THE LICENSE APPLICATION FOR THE HIGH-LEVEL WASTE REPOSITORY (CONT'D)

- BECAUSE THE FCRG HAS NEVER BEEN USED IN A LICENSING PROCEEDING, NRC AND DOE AGREED THAT DOE WOULD DEVELOP AN ANNOTATED OUTLINE OF ITS LICENSE APPLICATION BASED ON THE FCRG

- THROUGH DOE'S ITERATIVE DEVELOPMENT OF THE OUTLINE AND NRC'S REVIEW OF THE ITERATIONS, IT IS ANTICIPATED THAT THE FINAL FCRG WILL BE A MORE COMPLETE AND USEFUL DOCUMENT

STAFF TECHNICAL POSITION ON REGULATORY CONSIDERATIONS IN THE DESIGN AND CONSTRUCTION OF THE EXPLORATORY SHAFT FACILITY

- IF THE ESF IS TO BECOME A PART OF AN EVENTUAL GEOLOGIC REPOSITORY OPERATIONS AREA (GROA), THE ESF DESIGN SHOULD SATISFY APPLICABLE GROA REQUIREMENTS

- REVIEW CRITERIA FOR ESF DESIGN INCLUDE:

  1) ESF SHOULD LIMIT ADVERSE IMPACTS ON WASTE ISOLATION CAPABILITY OF THE SITE

  2) ESF DESIGN, CONSTRUCTION, AND OPERATION SHOULD FACILITATE COLLECTION OF NEEDED DATA

MONITORED RETRIEVABLE STORAGE

MONITORED RETRIEVABLE STORAGE MILESTONES

10/91	DOE STARTS MRS DESIGN WORK
09/92	CANDIDATE SITE(S) IDENTIFIED
03/95	DOE SUBMITS MRS LA TO THE NRC (10 CFR PART 72)
01/98	DOE STARTS WASTE ACCEPTANCE AT SIMPLE RECEIPT FACILITY
07/99	DOE STARTS WASTE ACCEPTANCE AT SPENT FUEL HANDLING BUILDING

VITRIFICATION

VITRIFICATION ACTIVITIES

- DOE IS RESPONSIBLE FOR VITRIFICATION OF FUEL REPROCESSING WASTE

  -- HANFORD, WASHINGTON
  -- SAVANNAH RIVER, SOUTH CAROLINA
  -- IDAHO FALLS, IDAHO
  -- WEST VALLEY, NEW YORK

- DOE HAS DEVELOPED A WASTE ACCEPTANCE PROCESS TO ASSURE GLASS PRODUCED IS ACCEPTABLE FOR ULTIMATE DISPOSAL IN A REPOSITORY

- NRC HAS NO LICENSING RESPONSIBILITY FOR VITRIFICATION FACILITIES

- NRC CONSULTS WITH DOE ON WASTE ACCEPTANCE PROCESS

DOCUMENT LISTING - BRITISH VISIT

Radioactive Discharges and Monitoring of the Environment 1990, Volumes I and II, British Nuclear Fuels plc.

Conditions for Acceptance by British Nuclear Fuels plc of Radioactive Waste for Disposal at Drigg. July 1991.

The Drigg Low-Level Waste Site Public Information Brochure, 1991.

EP2, The Second Intermediate Level Waste Encapsulation Plant, British Nuclear Fuels plc, 1990.

Deep Repository Project, Preliminary Environmental and Radiological Assessment and Preliminary Safety Report, Nirex Report No. 71, March, 1989.

Nuclear Installations Act 1965 (As Amended) "Standard" License

Health, Safety and the Environment, Annual Report 1990, British Nuclear Fuels plc.

Sellafield Repository Project, U.K. Nirex Ltd 2 of 4 and BNFL.

Going Forward, The Development of a National Disposal Center for Low and Intermediate Level Radioactive Waste, U.K. Nirex Limited, August 1991.

Radioactive Waste Management, British Nuclear Fuels plc, 1990.

Fact Sheets on Groundwater Flow and Radionuclide Dispersion.

The Evaluation of the Properties of Immobilized Intermediate Level Wastes. G.A. Fairhall and J.D. Palmer, British Nuclear Fuels plc, Sellafield.

The Conditioning and Storage of Intermediate Level Wastes in the U.K., W. Heafield and G. Fairhall, British Nuclear Fuels plc, Risley and Sellafield, respectively.

BNFL's First Encapsulation Plant Enters the Testing Phase, Nuclear Engineering International, December 1988.

Disposal of Solid Low Level Radioactive Waste in the United Kingdom, L.F. Johnson, Presented at International Forum on Nuclear Safety, Tokyo, Japan, 12 March 1991.

Low-Level Waste Disposal in the U.K.: Designing for Environmental Protection, P.D. Grimwood and L.F. Johnson. Presented at International Waste Management Conference, Korea, October 1991.

ENCLOSURE 6

U.K. Experience in Solid Low Level Waste Management, L.F. Johnson and P.B. Woollam, Presented at IAEA Seminar on Storage and Disposal of Low Level Radioactive Waste, Paris, France, 30 September to 4 October 1991.

Drigg Trench Capping Project for Drigg storage Depot, by White-Young Consulting Group, January 1989.

Waste Characterization and Control Arrangements Associated with Solid Low-Level Waste Consignments to the U.K. Drigg Disposal Site. P.D. Grimwood and K.G. Elgie. Presented at Waste Management '91, Tucson, Arizona.

Water Act 1989. Drigg: Consent to Discharge Waste Disposal Site Leachate.

Radioactive Substances Act of 1960. Drigg: Certificate of Authorization, Explanatory Memorandum to Accompany the BNFL Drigg Authorization. Drigg: Variation of Authorization, Explanatory Memorandum to Accompany the Variation Notice.

Radioactive Substances Act 1960, Disposal Facilities in Land for Low and Intermediate Level Radioactive Wastes: Principles for the Protection of the Human Environment.

Outline Programme

BRITISH NUCLEAR FUELS plc
SELLAFIELD

Visit on Monday 18 November 1991

Jane

Visit Supervisor Miss J Bufton

Hour

Sunday 17 November 1991

PM Arrive Sella Park House

1930 for 2000 DINNER

Hosted by:

Mr L F Johnson, Head of BNFL Waste Management Unit

Joined by:

Dr R Strong, Head of Environmental and Personnel Protection

Monday 18 November 1991

0850 for 0900 To Sellafield Visitors Centre

To be welcomed by:

Mr L F Johnson, Head of BNFL Waste Management Unit

To Eskdale Room

Coffee and Biscuits

Introductory Discussions

Video Presentation

Enclosure 7

Presentation

by

Mr L F Johnson, Head of BNFL Waste Management Unit

'Waste Management'

1000 Presentation

by

Mr N G M Coverdale, Manager, Environmental Survey

'Environmental Impact'

1030 for 1040 To Encapsulation Plant Site, B379

To Changerooms

Tour of Encapsulation Plant 1

1130 for 1135 to Sellafield Geological Investigation Site 2\4\5

Tour of Facilities

1230 for 1245 To Westlakes Hotel, Gosforth

Lunch

Hosted by:

Mr L F Johnson, Head of BNFL Waste Management Unit

Joined by:

Miss J Bufton, Information Officer

1... To Drigg Storage Depot

14... Discussion of LLW Management Practices

1500 Tour Drigg Visitors Centre

View Low Level Waste Disposal Facilities

View PCM Retrieval Facility

1545 for 1600 **To Sellafield Visitors Centre**

To Eskdale Room

Tea and Biscuits

Concluding Discussions

1615 Depart

PUBLIC RELATIONS DEPARTMENT
B113.1

12 November 1991