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DEC 4 1979

Mr. Sheldon Meyers
Program Director
Office of Waste Management
U.S. Department of Energy
Washington, D.C. 20545

Dear Mr. Meyers:

As we have discussed, the U.S. Nuclear Regulatory Commission (NRC) staff is conducting a review designed to 1) identify and categorize the types (and quality) of information we will need to make decisions concerning the licensing of geologic repositories; 2) determine whether there are programs, underway or planned, which will provide the needed information; and 3) decide to what extent NRC needs independent programs to develop such information. Since the bulk of the technical work is being done by the U.S. Department of Energy (DOE) and its contractors, it is essential that we understand how DOE programs relate to the NRC criteria under development and whether DOE programs are directed toward the information which NRC will need to make licensing decisions.

As a first step in our review we have prepared a tentative list of information needs (posed in the form of questions) based on our draft technical criteria. For working purposes information needs have been segregated into three categories: waste packaging, repository siting, and repository design. The list for waste packaging is enclosed (Enclosure 1). Similar lists for repository siting and repository design will be forwarded to you in about ten days.

We would now like to work with DOE to match these information needs with the appropriate DOE programs. As a first step we would like to meet with DOE and its contractors in Silver Spring on December 12-14, 1979 to discuss preparation of a draft document which matches DOE programs and NRC information needs in the area of waste packaging. We would like to schedule subsequent meetings for repository siting and repository design in early 1980.

It would be helpful at the meeting if DOE were able to describe the DOE waste solidification and packaging programs in enough detail to clearly show whether they address the types questions provided in the enclosure. Eventually we would like to obtain detailed information on all these programs including, location of work, principal investigator(s), funding and manpower history and projections, scheduled completion date and a description of and schedule for all deliverables.

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In light of upcoming budget hearings and the Commission Waste Confidence Rulemaking Proceedings it is essential to clearly describe the interplay of the various Federal Waste Management Programs. Colin Heath and I agreed in our meeting of November 7, 1979 that this type of interaction would be very useful and should be undertaken.

I appreciate your assistance in this important exercise which will not only help to describe the interplay between the DOE and NRC programs but will help tooassure that sufficient information will be developed to allow NRC to make timely licensing decisionswhile minimizing overlap in the DOE and NRC technical programs.

Sincerely,

Original Signed by
John B. Martin

John B. Martin, Director
Division of Waste Management

Enclosures:
As stated

cc: N. Carter, ONWI
C. Heath, DOE
G. Oertel, DOE
B. Garvin, SRL
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WASTE FORM

The package performance requirements will address [illegible], considering probability and consequences where appropriate.

I The Waste Package shall be a significant barrier (1), (6)	A) By containing radionuclides for 1000 years and as long thereafter as possible	1) Site and Package chemical behavior won't compromise the package (5)	a) Leaching (2) b) Solubility (3) c) Oxidation/Reduction d) Corrosion e) Gas generation
		2) Site and Package physical behavior won't compromise the package (4)	a) Thermal effects (15) b) Mechanical strength c) Internal and external stress
		3) Site and Package nuclear behavior won't compromise the package (14)	a) Radiolysis (13) b) Radiation damage to canister
	B) By releasing radionuclides as slowly as possible after containment failure (48)	1) Site and Package chemical behavior won't compromise the site (10)	a) Radionuclide precipitation b) Retardation c) Porosity d) Permeability e) Gas generation f) Chemical stability
		2) Site and Package physical behavior won't compromise the site (11)	a) Thermal effects (12) b) Mechanical effects
		3) Site and Package nuclear behavior won't compromise the site	a) Radiolysis b) Radiation damage to host rock
		4) Site and Package chemical behavior won't compromise the package (5)	a) Leaching b) Solubility c) Oxidation/Reduction d) Corrosion e) Gas generation f) Chemical stability
		5) Site and Package physical behavior won't compromise the package (4)	a) Thermal effects b) Mechanical strength
		6) Site and Package nuclear behavior won't compromise the package (14)	a) Radiolysis of water b) Radiation damage to waste form
II The Waste Package shall promote safe handling and operation	A) During transportation (43a)	1) From chemical considerations (40)	a) Fire hazards (39) b) Explosion hazards (38) c) Chemical hazards (40)
		2) From physical considerations	a) Geometry (44) b) Dispersibility c) Thermal load d) Structural strength
		3) From nuclear considerations	a) Shielding b) Surface contamination c) Criticality
	B) During handling (43b)(46b)	1) From chemical considerations	a) Fire hazards (39) b) Explosion hazards (38) c) Chemical hazards (40)
		2) From physical considerations	a) Geometry (44) b) Dispersibility c) Thermal load d) Structural strength
		3) From nuclear considerations	a) Shielding b) Surface contamination c) Criticality
	C) During emplacement (43c)	1) From chemical considerations	a) Fire hazards (39) b) Explosion hazards (38) c) Chemical hazards (40)
		2) From physical considerations	a) Geometry (44) b) Dispersibility c) Thermal load d) Structural strength
		3) From nuclear considerations	a) Shielding b) Surface contamination c) Criticality
	D) During retrieval (45)(58)	1) From chemical considerations	a) Fire hazards (39) b) Explosion hazards (38) c) Chemical hazards (40)
		2) From physical considerations	a) Geometry (44) b) Dispersibility c) Thermal load d) Structural strength
		3) From nuclear considerations	a) Shielding b) Surface contamination c) Criticality

ENCLOSURE 1

The following questions constitute a further level of detail, expanding upon the items in the right-hand column of the summary sheet.

1A1) Barrier-Containment-Chemical

a) Leaching

Can the leaching rate of the waste package be assured to be essentially zero? How?

What local conditions affect leaching rate?
How can these conditions be controlled to reduce leaching rate?

What leaching tests are reliable under what conditions?

What are the uncertainties and inaccuracies in leaching studies and techniques?

What is the probability that leaching will occur during appropriate timeframes?

How does the leaching rate impact on total release of radionuclides from the repository?

What are the consequences of a high leach rate?

What scenarios should be explored to investigate the role of leaching on release of RN's?

b) Solubility

What chemical species of waste are solubility limited?

What steps can be taken to increase the number of species that are solubility limited?

What conditions increase the solubility of the waste?

Can low solubility of all radionuclides be achieved?

How can low solubility of radionuclides be proved?
How can low solubility of radionuclides be monitored?

What are consequences of ignoring solubility considerations?
What is significance of ignoring solubility considerations?

What scenarios should be explored to investigate the role of solubility on release of RN's?

What tests exist for determining solubility?

How accurate are those tests?

What are the limits of those tests?

What are the effects of extraneous substances which might get into the waste?

c) Oxidation/Reduction

What are the most favorable redox conditions for keeping waste immobile? By and overall.

How are these redox conditions achieved?

How are these redox conditions proved/monitored?

What scenarios should be explored to investigate the impact of different redox conditions on RN release?

Should oxygen be limited? How?

d) Corrosion

What conditions minimize corrosion?

How is corrosion controlled?

How are conditions monitored to assure maintenance of noncorrosive local conditions?

What scenarios should be explored to determine impact of corrosion on RN release?

e) Gas Generation

What conditions might cause gas generation?
How much will be generated?
What will the gas composition be?
What are its hazards?

How can gas generation be detected/monitored?

What is the profile of gas pressure vs time?

What might affect the rate of gas generation?

What might control the rate of gas generation?

What are the consequences of gas generation?

What scenarios should be explored to investigate the effect of gas generation on containment of radionuclides?

IA2) Barrier-Containment-Physical

a) Thermal Effects

What thermal effects will occur?

What are their consequences?

How might these effects compromise the site/package?

What monitoring practices/devices can be used to verify thermal effects?

What scenarios s-ould be explored to investigate effect of thermal conditions on release of RN's?

b) Mechanical Strength

What mechanical strength is required for containment of radionuclides for 1000 years?

What conditions are needed for maintaining mechanical strength for 1000 years?

How can mechanical strength be assured for periods of time longer than actual tests?

What are the mechanisms and consequences of mechanical failure of the package?

What scenarios should be explored to investigate the role of mechanical strength of waste package in containing RNs?

c) Internal and External Stress

How could over pressure conditions be achieved/prevented?

How could over pressure conditions be detected/verified?

What are the consequences of over pressure conditions on containing RNs for 1000 years?

What scenarios should be investigated to learn potential for over pressure conditions which could compromise the waste package?

IA3) Barrier-Containment-Nuclear

a) Radiolysis

How might radiolysis lead to release of radionuclides?

How can radiolysis be detected and its effects measured?

How could the effects of radiolysis be mitigated?

What scenarios should be explored to investigate the potential of radiolysis to impact integrity of the waste package?

b) Radiation Damage

What types and degrees of radiation damage could compromise the waste package?

How can the degree and consequences of radiation damage be measured?

What scenarios should be explored to investigate the impact of radiation damage to the waste package on the containment of radionuclides?

IB1) Barrier-Migration-Chemical

a) Precipitation

What are the critical groundwater chemistry parameters (e.g. pH, eH, etc.) that affect radionuclide precipitation?

How the nearfield host rock mineralogy can be affected by the precipitation of certain nuclides on a long-term basis?

b) Retardation

How does the change of ion exchange characteristics due to chemical interactions affect nearfield retardation properties?

What are the mechanisms of retardation which may be affected by waste form/host rock interactions?

c) Porosity

Is the pore size changed due to chemical interactions between the waste package and nearfield rock?

Can precipitated nuclides block pores of the host rock?

d) Permeability

Identify the chemical reactions that may change the permeability of certain chemical forms (e.g. salt, complex, etc.)?

What are the critical environmental parameters for the above chemical reactions?

How may they be controlled?

e) Gas Generation

What are the amounts and types of gases that can be generated by chemical interactions between the waste package and nearfield rock?

What are the quantitative relationships between pressure buildup due to gas generation and overall nearfield integrity?

Can the function of backfill/absorbent materials be breached by gas generation and subsequent deformation?

How can gas formation be mitigated?

f) Chemical Stability

How is the long-term chemical stability of the host rock affected by introducing the waste package, thus upsetting the natural chemical equilibrium?

What can be done to minimize the changes in the rock brought about by the repository?

IB2) Barrier-Migration-Physical

a) Thermal Effect

What is the effect of thermal conductivity changes (caused by the repository) on overall migration rate?

What is the effect of thermal expansion/contraction (caused by the repository) on overall nearfield rock strength and integrity?

How can the changes in the properties of the rock be measured and minimized?

b) Mechanical

What is the relationship between waste package geometry and host rock's long-term mechanical strength?

What is the relationship between waste package weight and host rock's long-term mechanical strength?

What is the relationship between waste package void volume and host rock's long-term mechanical strength?

What properties of the waste package can affect the mechanical properties of the host rock?

How can these effects be measured and minimized?

IB3) Barrier-Migration-Nuclear

a) Radiolysis

What is the effect of radiolysis of the water in the host rock on chemical and mechanical integrity of the rock?

Does the corrosion rate change due to radiolysis of water?

If so, can it be measured, controlled, or minimized?

What are the effects of helium generated by alpha emitters?

What are the effects of gas generation due to radiolysis of organics?

How do parameters such as temperature, dose rate, and total does affect radiolysis?

b) Structure

What are the effects of high radiation fields on nearfield rock, structural characteristics such as lattice parameters, F-center formation and colloidal band formation, etc.?

IB4-6) The questions listed under IB1 through 3 apply.

II Operation - The following questions apply to each of the four operational steps.

IIA1) Operation - Chemical

a) Fire Hazards

What types of combustibles are possible?

How can they be detected?

How will fire be detected and controlled?

Is a minimum flash point needed to cause them to combust?

Is a minimum oxygen index needed for combustion?

What can be released during a fire?

Should the waste container be flame tested?

Under what conditions?

What are the effects of gases evolved during internal fires?

What are the effects of heat evolved during internal fires?

Can pyrophorics be treated to be made inflammable?

Can fire spread from a single container to others?

b) Explosion Hazards

What minimum conditions must exist for an explosion to take place?

Should/can detonation speeds be limited?

Should/can the container have a rupture disk?

Is a self-extinguishing capability possible?

What detonation mechanisms should be considered?
- Physical shock
- Electrical shock
- Temperature
- Pressurization

Should/can these mechanisms be limited as to minima which the canister can withstand?

c) Chemical Hazards

What types and amounts of gases might be released following a breach?

Should/can they be regulated?

What types and amounts of liquids might be released?

Should/can they be regulated?

Should chemical hazards be considered with respect to equipment damage?

IIA2) Operation - Physical

a) Geometry

Are there optimal canister size and weight according to probability and consequence analyses?

What package and handle designs are least likely to promote rupture according to probability and consequence analysis?

b) Dispersibility

What waste form properties control dispersibility best? Consider:

1. Compressive strength
2. Tensile strength
3. Impact strength
4. Ductility
5. Surface/volume ratio

c) Thermal Load

Should there be a maximum temperature allowable?

Should there be a maximum vapor pressure?

Should the waste form and container thermal expansion coefficients be matched? If not, what relationship should they have so as to minimize stress?

What gas evolution may result from fires in nearby containers?

What heat evolution may result from fires in nearby containers?

d) Structural Strength

What container material properties should be controlled? Consider:

1. Tensile strength
2. Compressive strength
3. Ductility
4. Ductile/brittle transition temperature

What container design properties should be considered? Include:

1. Impact resistance
2. Maximum compressive load

IIA3) Operation-Nuclear

a) Shielding

How much shielding is needed?

What types of radiation are anticipated?

What shielding backup is appropriate?

b) Surface Contamination

What is the maximum reasonable surface contamination?

By radionuclide?

How may it be checked?

How may deocntamination be accomplished?

c) Criticality

What situations could lead to criticality?

What accidents can lead to these situations?

Can the waste package be altered to alleviate these situations?

What methods will be used to prevent criticality?