ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 124, 144, 146, and 148

[FRL-3382-7]

Underground Injection Control Program: Hazardous Waste Disposal Injection Restrictions; Amendments to Technical Requirements for Class I Hazardous Waste Injection Wells; and Additional Monitoring Requirements Applicable to all Class I Wells

AGENCY: Environmental Protection Agency.

ACTION: Final Rule.

SUMMARY: The Environmental Protection Agency (EPA) is today promulgating its approach to implementing the statutorily mandated prohibitions on the underground injection of hazardous waste. This action is being taken in response to amendments to the Resource Conservation And Recovery Act (RCRA) enacted through the Hazardous and Solid Waste Amendments of 1984 (HSWA). In addition, the Agency is promulgating amendments to the existing Underground Injection Control (UIC) Regulations as they pertain to hazardous waste injection.

Today's notice codifies at 40 CFR Part 148, for those hazardous wastes that are disposed in Class I hazardous waste injection wells, the directly applicable sections of Part 268, the Agency's regulatory framework for implementing the land disposal restrictions (51 *FR* 40572 *et seq.* November 7, 1986).

Part 148 also specifies the effective date of the restrictions on injection of specific hazardous wastes. Today's rule includes effective dates for the restrictions on injection of solvent wastes and of dioxin-containing wastes. A recent proposal has specified effective dates for "California list" wastes (as defined by section 3004(d) of RCRA and at 52 *FR* 25760, July 8, 1987) and for certain wastes prohibited under section 3004(g) of RCRA (53 *FR* 14892 *et seq.*, April 26, 1988). Further proposals will specify effective dates for the remaining section 3004(g) wastes. Finally, Part 148 defines the two circumstances under which a waste otherwise prohibited from injection may be injected: (1) when the waste has been treated in accordance with the requirements of Part 268 pursuant to section 3004(m) of RCRA; or (2) when an applicant has demonstrated to the satisfaction of the Administrator that there will be no migration of hazardous constituents from the injection zone for as long as the wastes remain hazardous. Under this rule, an applicant may submit a petition to the Administrator containing the demonstration. An applicant may make a demonstration of "no migration" based on either: (1) an absence of fluid movement out of the injection zone; or (2) an active process of waste reduction, transformation, or immobilization within the injection zone. Upon a successful demonstration, the applicant will be granted an exemption from the prohibition.

Today's promulgation also contains changes to 40 CFR Parts 124, 144 and 146, the Class I injection well regulations. These amendments apply to owners and operators of all Class I hazardous waste well, including: those injecting wastes not yet subject to a prohibition, those injecting wastes which meet the treatment standards promulgated pursuant to § 3004(m) of RCRA, and those whose wastes have been banned and who have received an exemption under Part 148. The changes to § 124.10 and § 146.13 pertain to all owners and operators of Class I wells.

DATES: New Part 148, is effective July 26, 1988. All other amendments are effective August 25, 1988.

ADDRESSES: The official record for this rulemaking is located in Room 1013C East Tower, Office of Drinking Water (WH-550), U.S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460, and is available for viewing from 9:30 a.m. to 3:30 p.m., Monday through Friday, excluding legal holidays. The public must make an appointment to review docket materials by calling Eric Callisto at (202) 382-5508 for appointments.

FOR FURTHER INFORMATION CONTACT: John Atcheson, Office of Drinking Water (WH-550), U.S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460, (202) 382-5508.

SUPPLEMENTARY INFORMATION:

Preamble Outline

List of Subjects

I. Background

A. Statutory Authority

The Hazardous and Solid Waste Amendments of 1984 (HSWA), enacted on November 8, 1984, impose substantial new responsibilities on those who handle hazardous waste.

The amendments prohibit the continued land disposal of untreated hazardous waste beyond specified dates, unless the Administrator determines that the prohibition is not required in order to protect human health and the environment for as long as the wastes remain hazardous (RCRA sections 3004 (d)(1), (e)(1), (f)(2), (g)(5)). Congress established a separate schedule in section 3004(f) for making determinations regarding the disposal of dioxins and solvents and the list of wastes specified in section 3004(d)(2), termed the California list, in injection wells.

Wastes that meet the treatment standards set by EPA under section 3004(m) of RCRA are no longer prohibited and may be land disposed. The statute requires EPA to set "levels or methods of treatment, if any, which substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment are minimized" (RCRA section 3004(m)(1)).

Land disposal prohibitions are effective immediately upon promulgation unless the Agency sets another effective date based on the earliest date that adequate alternative treatment, recovery, or disposal capacity which is protective of human health and the environment will be available (RCRA sections 3004(h) (1) and (2)). However, these effective date variances may not exceed 2 years beyond the otherwise applicable effective date. In addition, two 1-year case-by-case extensions of the effective date may be granted under certain circumstances (RCRA section 3004(h)(3)).

For the purposes of the land disposal restrictions program, the statute specifically defines land disposal to include, but not be limited to, any placement of hazardous waste in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome or salt bed formation, or underground mine or cave (RCRA section 3004(k)). The legislation also sets forth a series of deadlines for Agency action. For a full explanation of the statutory framework the reader is referred to the preamble for the regulations that EPA has already proposed or promulgated under the statute, particularly 51 *FR* 1602 *et seq.*, January 14, 1986; 51 *FR* 19300 *et seq.*, May 28, 1986; 51 *FR* 40572 *et seq.*, November 7, 1986; 51 *FR* 44714, *et seq.*, December 11, 1986; 52 *FR* 21010 *et seq.*, June 4, 1987; 52 *FR* 22356 *et seq.*, June 11, 1987; 52 *FR* 25760 *et seq.*, July 8, 1987; 52 *FR* 32446 *et seq.*, August 27, 1987; 53 *FR* 11742 *et seq.*, April 8, 1988; 53 *FR* 14892 *et seq.*, April 26, 1988; and 53 *FR* 17578 *et seq.*, May 17, 1988. The following discussion describes more specifically the statutory framework for injection wells.

1. Section 3004(f)

Section 3004(f)(addresses the disposal by injection of solvents, dioxins, and California list wastes. Specifically, this section requires the Administrator to promulgate rules prohibiting the disposal of such wastes into wells if it may "reasonably be determined that such disposal may not be protective of human health and the environment for as long as the waste remain hazardous * * *". If EPA does not determine those instances where disposal would meet this standard, the injection of these wastes is prohibited under section 3004(f)(3).

2. Section 3004(g)

Section 3004(g) of RCRA applies the same standards and procedures to all methods of land disposal. It requires the Agency to set a schedule for making land disposal restriction decisions for all hazardous wastes listed or identified in 40 CFR Part 261 under RCRA section 3001(c) as of November 8, 1984, other than the wastes referred to in sections 3004 (d) and (e). EPA submitted this schedule to Congress on May 28, 1986 (51 *FR* 19300 *et seq.*).

Section 3004(g)(5) provides that the regulation promulgated by the Administrator must prohibit methods of land disposal except for methods "which the Administrator determines will be protective of human health and the environment for as long as the waste remains hazardous * * *".

Further, the section provides that, except for wastes which comply with the standards promulgated pursuant to section 3004(m), a method of land disposal may not be determined to be protective of human health and the environment, "unless, upon application by an interested person, it has been demonstrated to the Administrator, to a reasonable degree of certainty, that there will be no migration of hazardous constituents from the disposal unit or injection zone for as long as the wastes remain hazardous."

RCRA section 3004(g)(6) provides that if EPA fails to take action under section 3004(g)(5) by the statutory deadlines for any hazardous waste according to the schedule, such hazardous waste may be disposed of in landfills or surface impoundments only if such disposal units are in compliance with the minimum technological requirements set forth in RCRA section 3004(o) for new facilities. In this situation, placement of such wastes in other types of land disposal units (e.g., deep injection wells) would not be precluded by section 3004(g)(6). See 130, Cong. Rec. S9192 (daily ed., July 25, 1984). If EPA fails to set treatment standards, grant a petition or grant a variance under section 3004(h) for any of the scheduled listed wastes by May 8, 1990, then the particular wastes involved will be prohibited from land disposal.

The land disposal prohibitions apply to all hazardous wastes identified or listed under RCRA section 3001 as of November 8, 1984, the date of enactment of HSWA. For any hazardous waste identified or listed under RCRA section 3001 after November 8, 1984, EPA is required to make land disposal restriction determinations (i.e., establish treatment standards) within 6 months of

the date of identification or listing (RCRA section 3004(g)(4)). However, the statute does not impose an automatic prohibition on land disposal if EPA misses a deadline for any newly listed or identified waste.

B. Summary of the Land Disposal Restrictions Framework

The Agency has promulgated in 40 CFR Part 268 the regulatory framework for implementing the land disposal restrictions. (51 *FR* 40572 *et seq.*, Nov. 7, 1986). Corrections to the November 7, 1986, final rule were included in a June 4, 1987, **Federal Register** notice (52 *FR* 21010) to clarify the Agency's approach to regulating restricted wastes. Some changes to the framework were also made in the July 8, 1987, rulemaking on the California list wastes (52 *FR* 25760). Part 148 codifies the sections of Part 268 that are directly applicable to injection wells. In addition, today's rule specifies effective dates for restrictions on certain injected hazardous wastes. Part 148 also provides the standard and procedures by which petitions to dispose of an otherwise prohibited waste by injection will be reviewed and exemptions pursuant to these petitions will be granted or denied.

Part 148 is similar in approach to Part 268. The Agency believes, however, that it is useful to the regulated community and to the State regulators to have requirements regarding injection wells located in the same portion of the Code of Federal Regulations as are other requirements pertaining to these wells. Hazardous waste injection wells are regulated under the authority of both the Safe Drinking Water Act (SDWA) and RCRA. These regulations have been codified along with other regulations under the SDWA in Parts 124, 144, 145, 146 and 147 of the Code of Federal Regulations.

We expect that eventually the Part 148 standards will be implemented by the same State agencies that currently have primacy for the UIC program.

The framework which the Agency has promulgated to implement the land disposal restrictions for surface disposal facilities is as follows: For each waste that the Agency prohibits from land disposal, the Agency intends to promulgate treatment standards under Part 268, Subpart D that meet the requirements of section 3004(m) of RCRA. Once the standards are effective, restricted wastes may be land disposed of in a RCRA Subtitle C facility (e.g., a UIC Class I hazardous waste well) if they meet the treatment standard.

Upon the effective dates of the prohibitions, wastes that do not comply with the applicable treatment standards, or are not subject to a national capacity variance, or that do not have a case-by-case extension under § 268.5 are prohibited from placement in land disposal units unless an exemption has been granted by the Administrator under § 268.6 pursuant to a petition demonstrating that such disposal units will not allow migration of hazardous constituents for as long as the wastes remain hazardous.

For injection wells, EPA has adopted the same treatment standards that have been promulgated in Part 268 Subpart D for injected wastes, as provided in Part 148 Subpart B. After the effective date of a prohibition in Part 148 Subpart B, untreated wastes can only be injected if an exemption has been granted by the Administrator pursuant to a petition under Part 148 Subpart C, or, on a case-by-case basis, an extension to the effective date has been granted according to the procedures outlined in § 268.5. An extension may not exceed one year, and the Administrator may not renew it more than once.

C. Effect on State UIC Primacy

The requirements being promulgated today could affect the status of States with primary enforcement authority for the UIC program. Specifically, a State will have to amend its program to conform with the new regulations at Parts 124, 144, and 146 by April 24, 1989 (section 1422(b)(1) of the SDWA). Of course, a State which now prohibits Class I wells in general or injection of hazardous waste would not be required to make such a demonstration, since such a program would be more stringent than either existing or new UIC requirements.

The Agency notes that the new requirements will remove the existing "shield" for hazardous waste well permits. That is, under the previous regulations, permits could not be modified, revoked, or reissued to require compliance with new regulations unless the permittee requested or agreed. Under today's amendment to Part 144, new regulations would be grounds for initiating permit modification. These changes to Parts 124 and 144—unlike the effect of the land disposal restrictions which are immediately effective—will not take effect in primacy states until EPA approves the modification of the State program.

The Agency expects that part of a State's demonstration that its program conforms with the amended regulations would be an amendment to the Memorandum of Agreement where the state would agree on a schedule to modify existing permits, if necessary, to incorporate the new regulations.

States need not seek authorization to administer Part 148 to maintain UIC primacy. However, the Agency also expects that State agencies which have primacy for the UIC program will wish to implement Part 148, and receive authorization to grant exemptions from land disposal restrictions. However, before such authorization can be granted the State would have to demonstrate that it has authorization to implement §§ 3004 (f), (g), and (h) of RCRA. A thorough discussion of the conditions under which such authorization can take place can be found in 50 *FR* 28728 *et seq.*, July 15, 1985. In addition, where jurisdiction for UIC and RCRA do not reside in the same State Agency, EPA will require a Memorandum of Understanding between the two entities, clearly outlining responsibility for granting exemptions.

II. Summary of Today's Rulemaking: Response to Comments; Part 148

A. Proposed Standard for Demonstrating Protection of Human Health and the Environment

As noted in the proposal, sections 3004 (f) and (g) both require a demonstration that injection is protective of human health and the environment. Under section 3004(g) it is clear that such a demonstration must include a showing of "no migration" of hazardous constituents from the injection zone for as long as the wastes remains hazardous. EPA believes that the "no migration" standard of section 3004(g) helps define what is protective of human health and the environment under section 3004(f). Section 3004(g), by its terms, restricts the injection of certain hazardous wastes into injection wells. In the proposal, EPA noted that the wastes covered under section 3004(f) are just as hazardous to human health and the environment as those under section 3004(g), and concluded that injection of either set of wastes should be subject to the same standard. Thus, the Agency proposed that the demonstration should be similar for all injection wells regardless of the type of injected waste and that the "no migration" standard should apply to all. For this reason, the Agency is using a petition process and standard that is the same for all prohibited hazardous wastes that are injected, whether they fall under subsection (f) or (g).

Several commenters supported this interpretation of the law. Other commenters stated that the "application and demonstration" clause of sections 3004 (d)(1) and (g)(5) of RCRA would not

necessarily require procedures as rigorous or time consuming as EPA's proposed petition process. Moreover, these latter commenters point out that section 3004(f) simply does not contain the application and demonstration clause and could, therefore, differ in procedural approach.

1. Alternative Procedures for Implementing Sections 3004 (f) and (g)

Several commenters suggested an alternative approach whereby the Agency could make a determination that injection of wastes in accordance with the substantive standards of § 148.20 will be protective of human health and the environment. The Agency could then promulgate rules prohibiting injection which is not in compliance with these standards. Such action, the commenters maintained, would satisfy the Agency's mandate under sections 3004 (f) and (g).

EPA believes that RCRA provides significant latitude in the procedural approaches to determinations under sections 3004(d), (e), (f), and (g) of RCRA. Under any of these approaches EPA would need to support determinations under section 3004(g)(5) that there is "no migration of hazardous constituents while the waste remains hazardous" with sufficient technical basis, whether part or all of that basis is generic to the practice of hazardous waste injection. Under section 3004(f), EPA would need to support the finding that hazardous waste injection is "protective of human health and the environment". As a matter of policy, and not statutory mandate, EPA is approaching the standards for injection wells under sections 3004 (f) and (g) identically and is choosing the petition process in this final rule to make appropriate findings under both sections. The suggested alternatives which rely on more generic findings that the method of underground injection meets the standard along with facility certifications would not be as reliable as determinations based on site-specific demonstrations. To the extent that geology varies areally, the difficulty of modeling and characterizing the geology increases; the degree of uncertainty associated with a demonstration increases also.

2. Generic Petition Demonstrations

In the proposal, the Agency requested comment on a number of alternate approaches for satisfying the requirements of section 3004(f) of RCRA. These approaches were proposed in light of the Agency's ability to process "no migration" petitions in the period between promulgation of this regulation and the "hard hammer" deadline of August 8, 1988, for § 3004(f) wastes. One proposed approach was the submittal of generic petitions. Under this scenario, operators injecting the same waste into a single formation could submit one petition seeking an exemption from the ban, provided that the sites shared similar regional and basic site-specific geologies. Similarly, it was proposed that a single State could petition for a waiver from the ban for injection facilities within that State. These approaches received extensive comment, both pro and con. Commenters who disagreed with these approaches did so on the basis of what they perceived as petitioners' inability to submit information on geologies and waste streams that would be general enough to describe more than one facility, yet specific enough to insure "no migration" at every site.

The Agency understands this position, and realizes that successful petitions of this nature will be difficult to develop. This option is certainly within the legal parameters of a RCRA "no migration" demonstration, however, and as such, it will be a permissible petitioning alternative for the regulated community. The Agency has no intention of lowering the standards being promulgated today in allowing the use of generic petitions. Such petitions will have to adequately meet all of the regulatory requirements of Part 148 that insure protection of human health and the environment.

3. Scope of the "No Migration" Petition Demonstrations

Several commenters contended that exemptions granted pursuant to a "no migration" demonstration were intended by Congress to be limited in number. They inferred from the Agency's proposal that a sizable portion of the injection facilities might pass the demonstration and stated that this somehow violated the statute.

The Agency would like to note that until petitions are received and processed, EPA has no clear idea of the number of demonstrations which might be successful. Some very preliminary worst-case modeling performed by EPA did indicate that the demonstration was achievable by some. The Agency believes that Congress was setting a very stringent performance standard, not creating an arbitrary quota. Moreover, there is evidence that Congress recognized that some UIC wells could meet this standard (see S. Rept. 284 98th Cong. 1st Sess. at 14 and Cong. Record S. 9153, July 25, 1984). The exact number or percent of petitions which are deemed successful must be determined by whether facilities have the hydrogeologic or geochemical characteristics capable of meeting the standard, not on some predetermined number of sites which ought to be allowed to meet the standard.

4. Statutory and Regulatory Definition of Injection Zone

Several commenters sought to limit the statutory and regulatory term "injection zone" in a manner which, in EPA's view, (1) is not mandated by RCRA or the SDWA, (2) is not consistent with current regulations, (3) is irrational for the purposes of RCRA sections 3004 (f) and (g), and (4) would provide no benefits to environmental protection. At the heart of their argument is the concept that an injection zone may not contain confining material. Fluid penetration into such material, they would argue, is necessarily migration from an injection zone. EPA rejects these arguments.

The term injection zone under RCRA sections 3004 (f) and (g) and in the UIC program must have a functional meaning as the unit which must contain the waste. Containment can only occur within the relatively less permeable confining material. The legislative history of the 1984 HSWA amendments states that "[i]n determining appropriate confinement from which migration shall not be allowed to occur the terms disposal unit or injection zone should be construed . . . in terms of overall integrity of the disposal practice, keeping in mind, in particular the potential for contamination of groundwater or surface water resources" (S. Rept. 284 98th Cong. 1st Sess. at 15). Essentially, the UIC program permits the use of certain geologic formations or parts of formations in the inaccessible subterranean environment for waste disposal so long as this disposal is sufficiently removed from groundwater or surface water resources. There is no provision in the legislative history or RCRA sections 3004 (f) and (g) which states or implies that confining material is a resource which must not be used for disposal or cannot be part of an injection zone.

The legislative history of the 1984 HSWA amendments further indicates that the statutory term "injection zone" should match the regulatory definition in 40 CFR 146.3. That provision defines an injection zone as "a geologic formation, group of formations, or part of a formation receiving fluids through a well". Clearly under this definition permit writers must use their expertise and knowledge of local hydrogeology to determine the size and characteristics of injection zones. The current regulations

place other limitations on permit writers' discretion. First, under 40 CFR 144.3 and 146.3, hazardous waste injection must only take place below the lowermost formation containing within one-quarter mile of a well bore an Underground Source of Drinking Water (USDW). There must also be a confining zone which is "capable of limiting fluid movement above an injection zone" (40 CFR 146.3). The function of a confining zone is to oppose the upward pressures of injection and prevent fracturing of the geologic system. Nothing in this definition, however, states that an injection zone may not contain confining material or even that a confining zone may not include part of an injection zone. Only the functional ability to oppose upward migration is necessary.

Apparently, these commenters believe that there is always a discrete boundary where permeable material meets impermeable material and injection fluid would seemingly bounce off this barrier, with no penetration of the impermeable material. However, this notion does not conform with physical reality. First, within a formation or group of formations, there is often not a line where a large permeable strata meets relatively less permeable strata. Geologic formations, such as the ones encountered in the Gulf Coast Basin, for example, are often several hundred feet thick (Refs. 1, 2, and 3). Over such thickness, variations in lithology such as the interfingering of sands and shales often occur. Accompanying the lithological changes are variations in permeability, porosity, and hydraulic conductivities (Refs. 4, 5, and 6). Second, confining material might not actually repel fluids; they oppose upward movement, and where adequate, stop it. Thus, some amount of penetration into confining material within the injection zone can occur, but should not be considered migration for the purposes of RCRA sections 3004 (f) and (g), provided the penetration occurs within the injection zone.

Prior to the 1984 HSWA amendments, permit writers did not fully consider the extent of fluid penetration of confining material since that penetration was always well below the formation containing a USDW. The Agency's proposal made clear that the injection zone itself must be appropriate to contain hazardous fluids. These commenters' statement that this approach is unlawful is not well founded. Moreover these commenters offer no credible alternative. Accordingly, EPA maintains in this final rule the interpretation outlined in the proposal.

5. Hazardous Levels at the Unit Boundary

In the proposal, a petition under RCRA §§ 3004 (f) and (g) would satisfy the statutory standard if it showed that before injected fluid crossed the top of an injection zone or a point of discharge, the fluid was no longer hazardous. In its proposal, EPA suggested using health-based limits which have undergone peer review by the Agency and are used in RCRA delisting decisions and for clean closure demonstrations. In the absence of such standards, EPA proposed that the Agency require petitioners to demonstrate that concentrations had been reduced to three orders of magnitude below detection levels.

Although commenters generally expressed support for the use of health-based values to define hazardous levels, some objected to any use of health-based levels. These commenters believe that the statutory phrase in RCRA sections 3004 (e), (d), and (g) that there be "no migration of hazardous constituents while the waste remains hazardous" means that EPA may not allow a single molecule of a constituent listed in 40 CFR Part 261 Appendix VIII to leave an injection zone. The Agency specifically interprets the statutory phrase as requiring consideration of the fate of Appendix VIII constituents which are either injected or derived from injected waste.

EPA, however, believes that Congress, in the use of the term "hazardous" and the phrase "while the waste remains hazardous", was concerned that injected fluid which leaves the injection zone not be hazardous and thereby not contain Appendix VIII constituents at hazardous levels.

This interpretation is consistent with the language in the 1984 amendments which expressly direct the Agency to "tak[e] into account" the "persistence, toxicity, mobility, and propensity to bioaccumulate of . . ." hazardous wastes and their hazardous constituents in making determination with respect to deep well injections. *See* RCRA sections 3004 (f)(2), (g)(5), and (d)(1)(C). To take toxicity and propensity to bioaccumulate into account the Agency must necessarily consider concentration levels. This interpretation is further consistent with the Senate Report which states that the "no migration of hazardous constituents . . ." for as long as the wastes remain hazardous standard can be satisfied if the Administrator finds "that migration of the wastes will not occur while the wastes still retain their hazardous characteristics in such a way that [sic] would present any threat to human health and the environment." (S. Rep. No. 98-284 at 15.)

The emphasis on concentration levels, as opposed to single molecules, is deeply established in EPA's regulations. Ordinarily the term "hazardous constituents" has no regulatory effect unless concentrations are also considered. Thus, the use of the term "hazardous constituents" under EPA's interpretation of RCRA sections 3004 (d), (e), and (g) is consistent with EPA's rules and policies for listing and delisting hazardous waste as well as cleanup standards. The listing procedures, in effect prior to 1984, state clearly that solid waste containing any of the constituents listed in 40 CFR Part 261 Appendix VIII might be termed hazardous considering, among other factors, the concentrations of the constituents in the waste (40 CFR 261.11). (See also the delisting rule at 40 CFR 260.22; the clean closure rule (52 *FR* 8704, March 19, 1987); and the groundwater cleanup rules at 40 CFR 264.94(a) (2) and (3).)

It should be noted that wastes can be rendered nonhazardous in the sense of concentration (see proposal at 52 *FR* 32453), but there is no chemical reaction that will completely eliminate all molecules of some Appendix VIII constituents. Thus a standard based on single molecules would not reflect the reality of chemical transformations. Moreover, wastes may be rendered nonhazardous by means of chemical transformation, adsorption of heavy metals or some organics, as well as by several other mechanisms. Immobilization of heavy metals in the injection zone is obviously a desired result. Accordingly, the Agency believes the most logical standard under RCRA sections 3004 (d), (e), (f), and (g) consistent with the environmental concern is whether hazardous fluids ever leave the disposal units and not whether hazardous levels of constituents remain in the unit. Thus, the phrase "while the waste remains hazardous" should not reflect wastes which stay in the unit.

For mobile constituents, the distinction between migrating fluids and fluids still in the injection zone would make little difference under the 10,000 year containment approach in § 148.20 discussed below. After 10,000 years of containment constituents would either be immobilized or otherwise be at nonhazardous levels throughout the injection zone.

The stringent reading that no molecules may leave an injection zone is inconsistent with EPA's regulatory approach to what is and is not

hazardous for regulatory concerns. Commenters have not shown that EPA's approach violates RCRA and have not offered any other credible approach. Accordingly, EPA maintains in this final rule the approach proposed.

A few commenters objected to the use of MCLs as health-based limits on the theory that MCLs factor in elements of cost, and are therefore not truly health-based limits.

The Agency, in a recent rulemaking, determined that MCLs are, in fact, protective of human health (see 52 *FR* 25700–25701, July 8, 1987). Basically, MCLs are conditioned by the feasibility of treatment. As the discussion in the preamble to the rule cited above indicates, MCLs have been found to be protective of health, not withstanding consideration of this factor.

Several commenters objected to the proposal which would have required the petitioner to demonstrate that concentrations had been reduced to three orders of magnitude below detection limits in the absence of established health-based levels. In objecting, some noted that there was no relationship between our ability to detect a constituent and its potential health effects. Others noted that there is no fixed level which represents the detection limit. They contended that the technology used to detect constituents is rapidly evolving, and varies from lab to lab. Finally, some maintained that three orders of magnitude below detection levels was excessively stringent and would establish levels far below any which might arise from known health-based levels. Many of these commenters suggested that the petitioner identify levels of concern in the absence of established limits and demonstrate to the Agency that the limits selected are protective.

The Agency, after consideration, remains convinced that there must be a surrogate for health-based limits in cases where no such limits have been or can be expeditiously established. Further, EPA believes that detection limits form an appropriate basis for this surrogate. However, EPA agrees that three orders of magnitude may be excessive. Only in very rare cases does a waste pose a health threat at such low levels. The Agency considered the option of having the petitioner demonstrate a level which would not have a potential to threaten health, but rejected it. While we are not allowing petitioners to define health-based levels, we will use data supplied by them to allow the Agency to specify a level of concern. Several mechanisms exist which allow the Agency to formulate interim levels of concern on a very rapid basis where data exists, and the Agency would use these when more formal levels had not been established. Only in cases where very little data exists would EPA rely on a surrogate.

The final approach being specified today uses detection limits as the appropriate level when no health-based limit exists or can be developed expeditiously by the Agency. This is generally consistent with the approach for listing, delisting, and clean closure described above. Three orders of magnitude below detection might cause inconsistent results since sampling of injected fluid in the injection zone would not even pick up constituents below detection levels.

B. Applicability—Section 148.1

As proposed, § 148.1 identifies the regulated community and broadly indicates the situations under which a facility may receive a variance, exemption, or extension from the RCRA Land Ban. One commenter believed that there should be no withdrawal required for wastes injected prior to final EPA approval or denial of actual petitions. The commenter was responding to the statement in the proposal that "the Agency has determined that the restrictions limit the injection of wastes after the restriction deadlines, but do not apply to wastes injected prior to the applicable dates." (52 FR 32449)

The commenter is in part correct. The prohibitions do not apply retroactively, and therefore wastes injected prior to the effective date do not have to be withdrawn. However, the commenter's contention that the effective date of the restriction is keyed to the time of the Agency's decision on a petition, is incorrect. The effective dates for a given waste are those specified by the statute in section 3004(f) or promulgated pursuant to section 3004(g). Thus, waste withdrawn from the formation after the effective date of an applicable ban is subject to the requirements of RCRA section 3004 except in the case where withdrawal is soil or debris resulting from a cleanup activity under CERCLA or RCRA, in which case the waste is not subject to the "land ban" provisions until November of 1988 (see section 3004(e)(3)).

There may be situations (e.g., salt domes) where an injection technology is not identical to the technology addressed in this rulemaking. In such cases, EPA will accept petitions under the statutory standards and apply the technical standards from Part 148 which are relevant and appropriate, along with other standards necessary to meet the statutory requirements of sections 3004 (f) and (g).

C. Definitions—Section 148.2

In the proposal the Agency defined two new terms at § 148.2: "injection interval" and "transmissive fault or fracture". Some commenters believed that the new definitions were both warranted and adequately explicit. Others felt the new terms were warranted, but indicated that some needed further clarification or modification. Still others felt that the Agency needed to define additional terms or redefine already established terms in addition to those proposed on August 27.

Most of the comments received pertained to injection interval. Some organizations felt that this new definition led to a liberal interpretation of the injection zone, and presumably a less protective injection scenario. Others felt that the well screen itself could be defined as the injection interval under this definition, thereby creating an artificially small receiving formation. The Agency believes that the injection interval is a necessary delineation in light of the § 148.20 "no migration" demonstration. An essential part of the § 148.20 modeling requirements is the modeled distance the waste travels within the injection zone. This distance must be measured from a defineable point or area that is distinguished as that place in the injection zone in which the well is screened, or in which the waste is otherwise directly emplaced. That defineable point or area is the injection interval, and EPA today promulgates that definition as proposed.

The term "transmissive fault or fracture" received only positive comments, and is today promulgated as proposed.

Various commenters suggested the adoption of new or redefined terms. The Agency considered these suggestions and believes that, with the inclusion of today's two new definitions and those promulgated in Part 146, all terms required to define and regulate injection of hazardous wastes have been promulgated.

D. Dilution Prohibition—Section 148.3

In the proposal, the Agency adopted the prohibition on dilution by reference to § 268.3. This section prohibits dilution of restricted wastes as a substitute for treatment to achieve compliance with either a treatment standard or, in the case of the California List, to bring the waste below the applicable restriction level. The Agency received comments supporting this approach. Two commenters, however, requested

clarification on the point at which dilution would be established, with one suggesting the inclusion of preamble language from the July 8, 1987 (52 *FR* 25778) final rule which amended the Land Ban framework. The basis of the § 268.3 regulation was outlined in that final rule and applies to both injection wells and surface facilities. We are adopting the approach in that preamble.

Legitimate aggregation of waste streams to facilitate centralized treatment is not considered impermissible dilution. However, artificial aggregation of wastes to avoid a land disposal prohibition standard, or mixing substances that do not either themselves need to be treated or which do not aid in treatment, would be considered impermissible. Thus, § 148.3 is intended to prohibit dilution as a means of circumventing the requirements imposed by the land disposal prohibitions. The Agency does not intend to prohibit dilution which is necessary to facilitate treatment.

E. Case-by-Case Extensions—Section 148.4

In the proposal, the Agency incorporated by reference § 268.5 as § 148.4. Section 148.4 will permit the owner or operator of a hazasrdous waste injection well to submit an application to the Administrator demonstrating that a binding contract has been enetered into to construct or otherwise provide alternative capacity that cannot reasonably be made available by the applicable effective date due to circumstances beyond that applicant's control. Two commenters felt that such an extension should be applicable to owners or operators who have submitted "no migration" petitions and are waiting approval.

Variances, extensions, and exemptions from the UIC Land Ban exist in five forms: (1) an exemption as a result of a successful "no migration" petition pursuant to the requirements of Subpart C of Part 148; (2) a statutory exemption until November 8, 1988, if the waste has been determined to be contaminated soil or debris resulting from a response action taken under section 104 or 106 of CERCLA or a corrective action required under RCRA; (3) a variance if the wastes cannot be treated to the level (or by the method) specified by the treatment standard established in section 268, pursuant to § 268.44; (4) a variance granted for lack of alternative capacity pursuant to section 3004(h)(2) or RCRA; and (5) a case-by-case extension pursuant to section 3004(h)(3). Unlike the variances and extensions noted above, there is no statutory authority to allow for a case-by-case extension of the ban date for owners or operators who have submitted "no migration" petitions and are awaiting approval. In the case of a treatment facility under construction, an applicant can assure with some confidence that at some time treatment will be available. No such assurance can be made on the outcome of a petition; it may be approved or denied.

The Agency believes, moreover, that it was Congress' intent, when setting the so-called "hard hammer", to move the Agency and industry towards a swift and effective national hazardous waste management program that is protective of human health and the environment. Reviewing and acting on "no migration" petitions in a timely fashion is part of this program. As a practical matter, the promulgated and proposed treatment capacity variances should in most cases provide the Agency time to process the "no migration" petitions before the regulatory hammer falls; the Agency's inability to process a petition is not and cannot be the basis of an extension granted under section 3004(h)(3), however.

Another commenter supported the adoption of the case-by-case provision, but believed that it should be interpreted to include extensions for facilities which have contracted for raw materials that will render their final product non-hazardous, but which are currently unavailable. Although other factors must be considered (see § 268.5), the Agency believes that this is an appropriate interpretation of the statute, to the extent that the addition of such raw materials constitutes alternative treatment or recovery, since section 3004(h)(3) allows the Administrator to grant such an extension for the purpose of constructing *or otherwise* providing such alternative capacity.

F. Waste Specific Prohibitions—Sections 148.10 and 148.11

1. F001 through F005 Solvent Wastes

Section 148.10 sets effective dates for the restriction of injected solvent wastes. In addition, this section outlines the situations under which such effective dates do not apply. Comments were received on various provisions and standards adopted or proposed at this section.

Many organizations commented on the Agency's adoption of § 268.41 treatment standards for injected solvents. Under the authority of section 3004(m) of RCRA, the Agency identified in the November 7, 1986, rule, treatment standards applicable to the following spent solvent wastes (including solvent mixtures) F001, F002, F003, F004, and F005 based on the levels of treatment that could be achieved by Best Demonstrated Available Technologies (BDAT) for these solvents (51 *FR* 40573 *et seq.*):

Acetone
n-Butyl alcohol
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Cresols (and cresylic acid)
Cyclohexanone
1, 2-Dichlorobenzene
Ethyl Acetate
Ethylbenzene
Ethyl ether
Isobutanol
Methanol
Methylene chloride
Methylene chloride (from the pharmaceutical industry)
Methyl ethyl ketone
Methyl isobutyl ketone
Nitrobenzene
Pyridine
Tetrachloroethylene
Toluene
1, 1, 1-Trichloroethane
1, 1, 2-Trichloro-1, 1, 2-trifluoroethane
Trichloroethylene
Trichlorofluoromethane
Xylene.

The Agency proposed applying those treatment standards for solvent wastes that are currently injected. Some commenters felt that the BDAT established in § 268.41 is inappropriate for the large-volume, low-grade wastes bring injected. Others supported the adoption. According to the best data available to the Agency at this time, solvent wastes that are surface disposed differ from those that are deep-well injected only by amount, not by type. Accordingly, the Agency is today adopting the standards in § 268.41 as BDAT for injected solvent wastes.

The Agency has recently completed the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (the TSDR Survey) (Ref. 7). This comprehensive database consists of the best information available to the Agency at this time. The TSDR Survey indicates that approximately 40 million gallons of low concentration (less than one percent), surface disposed sovlent wastes will require some form of alternative treatment. The TSDR Survey also shows approximately 317 million gallons of deep well injected solvent wastes. The Agency is attempting to determine the concentration of these injected solvents, but current information shows at least 260 million gallons to be below 1%. The appropriate

treatment for these dilute solvents is wastewater treatment (steam stripping, carbon adsorption, biological treatment and wet air oxidation) followed by solidification/stabilization and combustion. The TSDR Survey indicates that only 75 million gallons of such capacity exists.

In addition, and as noted in the proposal, the Agency expects that wastes resulting from both corrective action activities mandated by section 3004(u) of RCRA, and CERCLA removal and remedial actions, will place substantially increased demands on available treatment capacity. Preliminary studies indiate that approximately 2.8 to 5.6 *billion* gallons of ground water containing solvents may be extracted from such sites between 1988 and 1990 (Ref. 8). Again, the concentrations of these wastes have not been determined; the Agency expects the additional quantity of wastes resulting from these actions to occupy any increased treatment capacity that might become available as facilities meet the minimum technology requirements of section 3004(o) of RCRA, as well as tank or other on-site capacity which might be developed over the next few years. Based on these data, EPA is promulgating the variance proposed on August 27, granting a two-year national variance for injected spent solvent wastes containing less than one percent total F001–F005 solvent constituents at the point of initial generation (i.e., when the wastes first meet the listing description) which are disposed of by injection in Class I wells. Today's rule does not establish effective dates for the commercial chemical products, manufacturing chemical intermediates, and off-specification commercial chemical products (P and U wastes) listed at § 261.33 that correspond to the F001–F005 spent solvent wastes. These wastes will be addressed in a later rule. This rule also does not cover the four newly listed solvents in the F001–F005 listing which were added after the date of enactment of the 1984 amendments to RCRA: benzene, 2-ethoxyethanol, 2-nitropropane, and 1, 1, 2-trichloroethane (51 *FR* 6538). The Agency is currently gathering data to characterize and evaluate these wastes.

One commenter indicated that wastes which naturally meet treatment standards should not require treatment, nor be banned. This was explicitly proposed at § 148.10(c)(1) and § 148.11(b)(1), and remains a part of today's promulgation.

One commenter noted that the Agency had failed to include in the prohibitions at § 148.10 the provision for wastes receiving a variance from the treatment standard obtained under 40 CFR 268.44. Section 268.44 was promulgated on November 7, 1986. It applies to situations where a particular waste stream cannot be treated to the level (or by the method) specified as the treatment standard. The Agency envisions that wastes may be subject to a treatability variance in cases where the treatment standard for a particular stream cannot be met because the waste differs significantly from the type of wastes EPA considered when establishing treatment standards. A particular waste may be significantly different from the wastes considered in establishing treatability groups, for example, if the waste contains a more complex matrix which makes it more difficult to treat. For instance, complex mixtures may be formed when a restricted waste is mixed with other waste streams by spills or other forms of inadvertent mixing. As a result, the treatability of the restricted waste may be altered such that it cannot meet the applicable treatment standard. In such a case, generators or owners/operators may petition the Agency for an alternative treatment standard. While the Agency does not presently have any information indicating that promulgated treatment standards are not applicable to injected hazardous wastes, it is conceivable that such a situation may arise. Consequently the Agency is adding language to § 148.10 that adopts a procedure to evaluate petitions for a variance from the treatment standard as promulgated at § 268.44.

At this time, EPA has limited information indicating concentrations for the remaining solvent-containing wastes which are injected. Therefore, the Agency may reexamine whether a variance for these wastes is warranted when more data becomes available. At this time, however, the Agency is setting an effective date of August 8, 1988, for the restrictions on F001–F005 wastes in concentrations equal to or greater than 1% at the point of initial generation (i.e., when the wastes first meet the listing description).

2. Dioxins

Many of the comments on § 148.11, the section setting an effective date for the restriction of underground injection of dioxins, mirror those received on § 148.10. Several commenters did not believe that § 268.41 treatment standards were applicable, while others supported the proposed section. The Agency identified in the November 7, 1986, rule, treatment standards applicable to dioxin wastes identified by the hazardous waste codes F020, F021, F022, F023, F026, F027, and F028. The Agency has granted a two-year variance to the effective date of the restrictions for these wastes which are surface disposed, based on lack of capacity. Utilizing the same rationale as explained above for § 148.10, the Agency is adopting § 268.41 treatment standards for injected dioxin-containing wastes. Current data available to the Agency show that no dioxin-containing wastes are presently being injected. Restricting the injection of these wastes would have a negligible effect on availability of treatment capacity. Therefore, as proposed, EPA is not granting a national variance to the effective date of the ban for injection of these wastes. The effective date of the restrictions is August 8, 1988. The § 268.44 alternative treatment variance is being adopted for dioxin wastes as it was for solvents at § 148.10.

3. Other Proposed Prohibitions

Many commenters, in addition to supporting variances for both solvents and dioxins, also supported variances for injected "California list" wastes (as defined in RCRA section 3004(d) and the July 8, 1987, rule (52 *FR* 25760)) as well as wastes classified under section 3004(g) of RCRA. The April 26, 1988, notice (53 *FR* 14892 *et seq.*) contained effective dates for the California list wastes and a portion of the section 3004(g) wastes. Further notices will propose effective dates for the remaining section 3004(g) wastes.

G. Petition Standards—Section 148.20

This section outlined the specific standards the Agency proposed to apply to petition demonstrations. In summary, EPA proposed that the demonstration could be made on the basis of either waste transformation or fluid flow. Either demonstration would rely on the use of models as well as Agency-recommended health-based limits to define concentrations of waste constituents which would be considered hazardous. These levels, which have undergone peer review by the Agency, are used in delisting decisions and for clean closure demonstrations (See 52 *FR* 8704, March 19, 1987).

The Agency proposed that a demonstration based on fluid flow would have to show that the waste did not reach a point of discharge for a period of 10,000 years. In addition, EPA maintained that molecular diffusion was not a significant source of solute transport and therefore proposed that diffusion not be considered as part of a demonstration. A successful showing

would also have required the petitioner to comply with certain amended provisions of Part 146. As an additional safeguard, a petitioner would have to show that the confining zone was four times thicker than the vertical distance which the waste was expected to move in the injection zone, and that the injection zone was separated from the lowermost USDW by ten times that distance.

The Agency received extensive comment on this framework. In general, commenters were supportive of much of the proposal and indicated that it was consistent with statutory standards in sections 3004(f) and (g). A summary of the comments, the Agency's responses, and the final approach for each of these requirements follows.

1. Basing Determinations on 10,000 Years

The proposal specified that when modeling flow, the petitioner demonstrate that the waste would not reach a point of discharge, either vertically or horizontally, for a period of 10,000 years. As noted in the proposal, the Agency specified the 10,000 year time frame not because migration after that time was of no concern, but because it believed a site which could meet a 10,000 year time period would both provide containment for a substantially longer time frame, and allow time for geochemical transformations which would render the waste nonhazardous or immobile (Refs. 9, 10, 11, 12, 13, 14, and 15).

There was considerable comment on this provision. Some believed the time period to be far too long. Their suggested alternatives ranged from 100 to 1000 years. In support of these shorter time frames, these commenters pointed to language in House Report No. 198 (Pt. 1, 98th Cong., 1st Sess. at 33) which talks in terms of hundreds of years. Several also suggested that it is difficult to model accurately over such long time periods.

Others indicated that a 10,000 year time frame did not provide the "reasonable degree of certainty" required by the statute that hazardous waste would not migrate out of the injection zone.

The Agency has reviewed these comments and after careful consideration believes the 10,000 year demonstration stikes an appropriate balance between the need to demonstrate "no migration" with a reasonable degree of certainty and the limits of the technological means of making that demonstration. It should be noted, that EPA's standard does not imply that leakage will occur at some time after 10,000 years; rather, it is a showing that leakage will not occur in that time frame. As noted in the proposal, there is a considerable body of evidence suggesting that waste will either degrade to nonhazardous constituents or otherwise be attenuated well within a 10,000 year time frame.

One commenter cited one of the documents referenced in the proposal and noted that while organonitriles and nitrate were converted to CO_2 and N_2, sodium thiocyanate showed relatively less reduction in concentration (Ref. 14). The commenter concluded that this somehow invalidated EPA's selection of 10,000 years for the term of a demonstration. In this study, residence time of the waste in the injection zone was less than 70 *hours*. While observation of waste degradation in such a short time does affirm that waste will degrade in very long time frames, lack of total destruction in hours says nothing about the fate of waste in 10,000 years. Thus, EPA rejects the notion that the proposed standard is "* * * refuted by our own cited references."

Concerning those commenters who questioned the accuracy of modeling over a 10,000 year time frame, the EPA would like to note that many of these same commenters had correctly pointed out elsewhere in their comments that modeling need not locate the exact point where the waste would be at that time; determining where it would not be is sufficient. This level of precision is achievable.

2. Molecular Diffusion

In the proposal, the Agency suggested that movement of contaminants by molecular diffusion would not result in migration of hazardous constituents outside the injection zone at hazardous levels. As a result, EPA proposed that the petitioner need not consider diffusion in the demonstration required in § 148.20.

The Agency received extensive comment on this approach, with some expressing strong support, and others objecting to it. Some commenters offered technical information supporting the Agency's proposed approach. Of particular interest to all commenters was a study conducted by EPA (Ref. 16). Several commenters did not appear to understand that this study represented an extreme worst case anaylsis designed to determine the absolute upward limits of movement at hypothetical sites which could occur as a result of diffusion. Others noted the coefficients used were more representative of coarse sediments than those found in strata capable of confining fluids. One commenter stated that modeling movement due to diffusion was straightforward, and that sharply defined upward limits could be easily and accurately identified. As a result, this commenter contended that movement due to diffusion should not be subject to any additional safeguards if it is considered in a demonstration.

The Agency has reviewed the comments submitted, the new data provided, and refined its own analysis, and remains convinced that in most cases diffusion does not represent a significant source of solute transport that would result in vertical movement of hazardous levels of constituents (Ref. 17). However, the Agency does believe that this might not be true in all cases; thus, the determination of whether diffusion is a significant source of movement must be made on a case-by-case basis. Accordingly, EPA, in this rule, will require that any movement due to diffusion be accounted for in the demonstration. The Agency notes that diffusion is accounted for in most models used to simulate flow in deep, mineralized systems. Consequently, we do not believe there is any significant burden associated with requiring consideration of diffusion.

3. Use of Models

The proposed framework was based on predictions of waste location and fate over the very long term, and as such relied on modeling flow or waste degradation or attenuation. Commenters were generally supportive of this approach, but several expressed concern over the accuracy of modeling over time frames of up to 10,000 years. The concerns over modeling for very long time periods have already been discussed. Moreover, the issue of defining an appropriate maximum time frame for modeling has been addressed by the Science Advisory Board (SAB) and they endorsed periods up to 10,000 years (Ref. 18).

Some commenters, however, objected strenuously to the use of models in demonstrations and contended that there was neither a sound technical basis nor the legal authority to do so.

The Agency disagrees with both of these propositions. Nothing in sections 3004 (f) or (g) of RCRA or the legislative history forbids the use of models to form the basis for a "no migration" petition. The final approach relies upon conservative modeling techniques to evaluate the potential for migration of hazardous constituents from the injection zone. Fluid flow modeling is a well-developed and mature science and has been used for many years in the petroleum industry. More recently, fluid

flow models have been further developed for the Department of Energy nuclear waste isolation program.

Specifically, a wide range of models exists that provide the capability to analyze pressure build up, lateral waste migration, vertical fluid permeation into overlying confining material, and leakage through defects in overlying aquitards (Refs. 15, 19, 20, 21, 22, and 23). Models make it possible to predict tendencies or trends of events that have not yet occurred or that may not be directly observable. Under the "no migration" standard, a demonstration need not show exactly what will occur, but rather what conditions will not occur. Conservative modeling can be used to "bound the problem" and can legitimately form the basis for the petition demonstrations.

Specific hydrogeologic data and operational data are necessary to make a demonstration, and EPA will carefully analyze modeling assumptions. Where some uncertainty exists about the data, the demonstrator may conduct sensitivity analyses to determine the range of error this uncertainty could introduce into a demonstration.

There will be, moreover, an opportunity for public comment on the appropriateness of the simulator selected, the data used, and the assumptions made in any demonstration.

Finally, the commenters who are contesting, as a general matter, the validity of modeling have offered no technical basis for their objections, nor have they provided specific suggestions to improve the data or analytic approaches.

General statements such as these do not provide useful or credible alternatives for EPA to implement sections 3004 (f) or (g). Therefore, since (1) nothing legally prohibits the use of models, (2) appropriate modeling has a sound technical basis, and (3) commenters have offered no indication that there are any specific pitfalls to this approach, EPA does not in this final rule prohibit the use of modeling to form the basis of a petition demonstration for underground injection wells.

4. Use of a Safety Factor

In the proposal, the Agency stated that demonstrations would be based on modeling and that direct verification of the absence of migration would be problematic due to the difficulty of effectively monitoring the location of a fluid front at depths ranging from 1500 to 5000 or more feet. In addition, during the regulatory negotiations which helped in the formation of the proposal for this rule, some representatives wanted to limit the permit writers' discretion by requiring that injection zones have vertical limitations. To deal with these concerns, EPA proposed that the confining zone be four times thicker than the total vertical distance that fluid was expected to move within the injection zone and that the injection zone be separated from the lowermost USDW by ten times that calculated distance (4x/10x).

As noted in the proposal, a further purpose of this provision was to deal with the uncertainties which some members of the regulatory negotiation committee felt were inherent in demonstrations based on modeling. In addition, this provision was seen as providing some additional protection against the likelihood that permeable faults or fractures might transect the confining zone.

The Agency received extensive comment on this requirement. Most stated that they believed the requirement to be excessive and unnecessary, and some believed it to be arbitrary. Several commenters noted that EPA had intentionally rejected the use of rigid numerical standards elsewhere in the proposal, noting that qualitative considerations were often important in making decisions regarding siting (52 *FR* 32458) and waste migration. One commenter objected to the proposal, but suggested it could be workable if an alternative to the "4x/10x" requirement was available.

A few expressed limited support for the concept, but indicated that if the Agency were to restrict the definition of injection zone, such a provision would be unnecessary.

One commenter wanted to reinstate a "containment zone," which is a concept introduced during the regulatory negotiation.

Finally, some requested clarification of how this distance should be measured. Commenters suggested that if the Agency were to adopt this approach, the appropriate point of measurement should not be the screened interval, but some larger area which is defined by the geology of the site.

After careful consideration, the Agency has determined that the requirement is unnecessary and may not be appropriate for several reasons. One of the key difficulties in implementing a "4x/10x" provision is the lack of proportionality between the initial fluid penetration into confining material and the additional safety provided by a multiple of that initial penetration. There is not necessarily a relationship between the quality of confining material in the injection zone and material some distance above. Thus, the requirement of further distance proportional to "x" is somewhat arbitrary.

Moreover, as mentioned above on the discussion of injection zones, there may be no discrete line to begin the measurement of "x" because of the interfingering of permeable and relatively less permeable material. Trying to determine with any consistency a point beyond the area of active emplacement into permeable material would be extremely difficult. This approach would also tend to encourage placement of well perforations nearer to confining material, which is not necessarily a desirable result in most geologic settings.

Further, the Agency's own analysis has shown that the "4x/10x" provision may not always afford the level of protection EPA was seeking. For example, modeling has shown that the "x" value may be quite small, in some geologic settings yielding values less than 10 feet (Ref. 15). Such low figures would not, under most circumstances, provide protection against transmissive faults or fractures.

Second, the Agency believes that any uncertainties resulting from the quality or extent of geologic data available are better addressed by assuring that conservative values are used, and that sensitivity analyses are conducted where appropriate, to enable the reviewer to assess the amount of variation in performance which might result from a given assumption.

Third, with regard to uncertainties associated with verification, the Agency would like to note that monitoring of pressure decay rates when the well is shut-in, provide effective means of determining whether the waste is behaving as a model predicted it would (Ref. 22).

Fourth, the Agency rejects the contention that modeling inherently introduces uncertainty into the demonstration; modeling has been used extensively in oil field exploration and enhancement with very good results (Ref. 23). Such applications involve the analysis of multiple points of injection and withdrawal and often involve two-phase flow—an application of considerably greater complexity than that required for "no migration" petitions submitted pursuant to § 148.20. Moreover, within the last few years, fluid flow models have been further developed for the Department of Energy nuclear waste isolation program (Refs. 24 and 25). Beyond this, EPA would like to note that models need not identify the precise point to which a plume may

move. Rather, the model can be used to bound the problem, showing a point to which the plume cannot move.

Finally, the Agency would like to point out that requirements currently in place and others being promulgated today in § 146.62 in Subpart G apply substantial safeguards to siting of injection wells. To the extent that such requirements apply to areas outside the injection zone, and address endangerment of USDWs and not prevention of migration, EPA believes that Part 146 is the appropriate regulation in which to promulgate these rules. Nevertheless, the requirements still serve to limit the regulatory agency's discretion, and provide additional safeguards addressing the concerns which the "4x/10x" requirement sought to address.

As a practical matter, the Agency believes that the petition reviewer will be sufficiently constrained by requirements in § 148.21 as it is being promulgated today. The final rule specifies more clearly that assumptions must be reasonably conservative, and that sensitivity analyses must accommodate any significant uncertainty in the geologic characterization or other aspects of the demonstration.

5. Requiring Compliance With Certain Part 146 Requirements

The Agency proposed that as part of the petition demonstration, the applicant certify compliance with the proposed Area of Review (AOR) and Corrective Action requirements from Part 146, as well as submit the results of a pressure test and a radioactive tracer survey (RTS) conducted within six months prior to a petition submission.

Commenters were generally supportive of the proposed approach, although some requested clarification on whether the UIC permit needed to be revised. Several commenters suggested that EPA's proposal to require that a well pass a mechanical integrity test within 6 months prior to petition submittal was too restrictive. They argued that such tests were unnecessary because they are currently required in the UIC permits, the six-month time period was counter-productive and could discourage submission of petitions in a timely manner, or that other tests could adequately serve to make the requested demonstration. Finally, some commenters contended that all or some expanded set of the amended UIC requirements should be met as a prerequisite to petitioning.

a. Permit Modification. The Agency did not envision requiring UIC permits to be modified as part of complying with amended Area of Review, Corrective Action or mechanical integrity requirements. It was the Agency's intent that the operator *certify* compliance with AOR and Corrective Action requirements, and that the operator submit results of a recent pressure test and RTS test. This is the approach being promulgated today in the final rule.

b. Timing of Mechanical Integrity Tests. EPA agrees that requiring operators to conduct a pressure and RTS test within 6 months prior to submitting a petition is too restrictive. As noted by some commenters, this requirement could have the effect of discouraging submission of petitions in a timely manner. The Agency's primary concern was that the well have a recent demonstration of integrity prior to approving or denying a petition. Since EPA can envision circumstances in which petition reviews may take considerably longer than 6 months, the final rule requires the owner or operator to submit the results of a pressure test and a RTS test with a petition. The tests must be conducted within one year prior to submittal of a petition. If the petition has not been approved or denied within one year after the MIT test was performed, the Director may require the owner or operator to perform another and submit the results.

c. Requiring Compliance with Other Part 146 Standards. One commenter suggested that at a minimum, the siting provisions in § 146.62 should be an integral part of the petition demonstration. Other commenters suggested that the Agency require compliance with all the provisions of proposed requirements in Subpart G of Part 146 prior to approving a petition.

First, the Agency would like to note that the siting requirements of § 146.62 with regards to injected waste are either subsumed in the standard set in § 148.20 or are rendered unnecessary by a successful demonstration. Moreover, the § 148.20 requirements are more stringent than the § 146.62 requirements. By definition, compliance with § 148.20 would demonstrate "no migration" whereas compliance with § 146.62 would demonstrate no endangerment, a considerably lesser requirement with regards to hazardous waste. Thus, imposing the requirements in § 146.62 as part of a petition demonstration would, at best, be redundant. The Agency believes the Part 146 requirements are necessary to effectively regulate hazardous waste injection which has not been banned and is therefore not subject to Part 148 requirements, and to assure that USDWs are not endangered from formation fluids.

Second, the 1984 HSWA amendments do not require a general overhaul of existing technical UIC regulations for hazardous waste injection and EPA does not believe there is an acute need for amendments to these regulations. The normal process of program review and the regulatory negotiation process did lead to the development of several useful proposals for clarifying, updating, or expanding existing regulatory requirements. Many of these standards are currently part of the UIC regulatory structure but are simply not stated in descriptive detail. EPA believes that adherence to current EPA technical permitting standards along with the new area of review and mechanical integrity requirements provides operational integrity of the delivery system to a reasonable degree of certainty. The Agency's additional findings under the petition process will fully satisfy the statutory standards under RCRA sections 3004 (f) and (g).

The commenter's proposal that new Part 146 standards must be in place before petition approval, is unworkable and unnecessary. Because sections 3004 (f) and (g) are HSWA requirements, that approach would essentially require EPA to run an entirely new UIC permitting scheme on top of those run by UIC primacy states. The petition review and permitting process are not identical under the statutes. This dual and redundant permitting and enforcement scheme would run until UIC primacy states had obtained HSWA authorization and would essentially require federal repermitting of every UIC facility. EPA does not believe Congress, in RCRA sections 3004 (f) and (g), mandated or envisioned such a sweeping and disruptive approach in permitting. While the Agency obviously favors today's revisions to the permitting program, and may in the future seek further changes, it does not believe such changes are intrinsically linked to decisions under RCRA sections 3004 (f) and (g). Moreover, commenters have not shown that any particular aspect of the UIC regulations are so critically inadequate that adherence to them in lieu of the new standards would necessarily fail the statutory mandates of RCRA.

H. Information To Be Submitted in Support of Petitions—Section 148.21

Section 148.21 of the proposal specified criteria which the information submitted in support of a petition must meet. In addition, §§ 148.21 (b) and (c) listed certain site-specific information that should be part of a petition. A few commenters noted that no single

modeling method or proprietary model should be required for all submitting sites. The Agency agrees with this position, and believes the proposed language at § 148.21(a)(3) allows flexibility in the choice of models, provided that the model has been validated, verified, and calibrated to assure that it is suited to the site to which it is applied.

Some commenters felt that the requirement for a sensitivity analysis in § 148.21(a)(6) was not clearly stated. The Agency's intent in proposing this section was to require the petitioner to: (1) Identify areas where the geologic characterization (or other phenomena) contained significant uncertainty; (2) determine a likely range over which values might vary; and (3) perform sensitivity analyses which would determine the magnitude of the fluctuations in performance which might result from these variations. The Agency agrees with those commenters who believed the rule was unclear and is promulgating more specific language in this section.

One commenter requested the inclusion of justification in § 148.21(a)(5) for the use of reasonably conservative values whenever values taken from the literature or estimated on the basis of known information are used instead of site-specific measurements. The commenter apparently believed that data from the literature is not always inferior to site-specific data. For example, in areas of extensive drilling and extensive, homogeneous sedimentation, data from off-site may provide a high degree of certainty in the characterization of local geology. The Agency agrees that information from the literature can provide certitude. Section 148.21(a)(5) should be viewed in the total context of § 148.21; when the geology can be accurately described and the bounds of uncertainty established, the sensitivity analyses may be more sharply defined; when there is some doubt concerning the geologic description, these analyses must be more broadly defined. Thus, the definition of what constitutes "reasonably conservative values" in § 148.21(a)(5) would be defined by the degree of certainty which results from the use of information from the literature or estimated values. The Agency believes that reasonably conservative values are those which result in models and subsequent operations that are protective of human health and the environment. It is difficult to codify such values, however, in light of the varied wastes, geologies, and operating circumstances that are covered under deepwell injection. The Agency believes that specific, suitably conservative values can be established by the reviewer during the course of petition evaluation.

One commenter believed that § 148.21(b)(2) should include the "layer of protection" required in 146.62(d)(1). As noted in Section (II)(G)(5)(c) of this preamble, the siting requirements of Part 148 are more stringent than those of Part 146, and would subsume such Part 146 requirements. Any petition that satisfies §§ 148.20 and 148.21 requirements automatically meets the requirements of § 146.62, with respect to injected wastes.

One commenter noted that, in regards to the geologic information requirements of § 148.21(b), "* * * Unless the proposed well is located in an area of dense drilling, the geologic data necessary for mapping [of the injection site] is likely unavailable." Most hazardous waste injection wells are sited in the Gulf Coast and Great Lakes regions, areas with long histories of drilling practices, and subsequent extensive geologic mapping. It is true that some facilities exist in areas where little or no previous drilling has occurred. Again, the amount and density of specific points needed to characterize geology is a function of the degree of isotropy and homogeneity exhibited by the sedimentary basin. The Agency believes that in many cases the owners or operators of sites may need to gather additional geologic data on their sites before a successful petition can be developed. The Agency believes that detailed geologic mapping is a reasonable request in the context of this regulation. A "no migration" demonstration cannot be established without it.

One commenter believed that existing and anticipated post-operational vertical fluid density gradients as well as vertical hydraulic gradients should be considered in evaluating the potential for vertical movement. The Agency agrees, but would like to note that a "no migration" demonstration under § 148.20 cannot be made without such factors being considered.

Several commenters objected to the requirement that, "All waste and environmental sampling, test and analysis data shall be accurate and reproducible and performed in accordance with quality assurance standards." They noted that in many cases, petitions will be based on information gathered during the drilling of the well—information which cannot be reproduced in accordance with procedures specified long after the drilling occurred. These commenters also noted that much of the data relied upon for characterizing the regional geology will be obtained from operations which are conducted by entities other than the petitioner. These commenters believed that the net effect of this requirement would be to prohibit the use of vast amounts of data. The geologic descriptions would therefore be less accurate, they contended.

The Agency agrees. Excluding historical data or information which might have been gathered off-site by methods not consistent with certain prescribed procedures may be counterproductive. The purpose of §§ 148.21(a) (5) and (6) should be to allow the use of such data, but assure that its limitations are accounted for in a petition review. Accordingly, EPA will require that only measurements pertaining to the waste or that result from testing performed to gather data for the petition demonstration comply with prescribed procedures. The Agency believes, however, that the concerns about the accuracy of geologic data are addressed more appropriately by requiring that the demonstration identify and account for limits on data quality rather than by excluding data from consideration. Again, § 148.21(b), as revised, requires precisely such consideration. Therefore, the demonstration in § 148.20 as promulgated, will allow the use of existing data.

I. Procedures for Petition Submission, Review, and Approval or Denial—Section 148.22

Some commenters stated that the petition review process in the proposal would not provide an adequate opportunity for public oversight. Commenters suggested a 45-day period for review, and an opportunity for public hearings due to the complex nature of the demonstrations. Other commenters believed that the proposed petition process is unworkable and would, due to the amount of time necessary to process petitions, result in sound hazardous waste management practices being outlawed by procedural difficulties. These commenters suggest a generic determination for injection wells and a minor modification approach to changes required in permits.

The Agency is doing everything it can to inform and coordinate with the regulated community on petitions, including several outreach meetings and close coordination with States and Regional offices. The "hammers" in the 1984 HSWA Amendments do create resource and timing problems, but as explained above, EPA favors the

petition process as a way of examining the specific hydrogeologic setting for determinations under sections 3004 (f) and (g). We further agree that the petition information is complex and the procedures would benefit from a 45-day comment period and the opportunity for public hearings. We incorporate such provisions in the final rule. In addition, we clarify here that the more extensive public notice provisions in 40 CFR 124.10 which apply to RCRA permits will apply to the Part 148 petition process.

In order to minimize the duplication of administrative procedures, we are providing that the Director may make certain related permit modifications to the UIC permit contemporaneously with the petition process through the procedures in § 148.22. These modifications include identification of an injection zone or an injection interval, redetermination of a well's area of review under § 148.20(a)(2)(i), application of a protocol for location of abandoned wells under § 148.20(a)(2)(ii), submission of a corrective action plan under § 148.20(a)(2)(iii), and performance of a radioactive tracer survey under § 148.20(a)(2)(iv). These items will then be enforceable both as permit conditions and as conditions of the petition. This approach will streamline the process and focus Federal administrative resources in an efficient manner.

State primacy programs will, of course, follow their own permit modification procedures. We will try and coordinate as closely as possible with primacy states. As discussed above in Section (II)(G)(5) of this preamble, nothing in this final rule requires permit modifications to satisfy the conditions of § 148.20. However, we believe a coordinated approach would prevent needless duplication of procedures.

J. Review and Termination of Exemptions—Sections 148.23 and 148.24

The Agency proposed in § 148.23 that petition demonstrations be reviewed at the time of permit renewals. Under the proposal, the Director could require a new demonstration if new information showed that the basis of the demonstration were no longer valid. This section also provided the Director the authority to require a new demonstration at any time information indicated that the basis of the showing was not valid or was no longer valid. Section 148.24 listed reasons for which the Director could terminate exemptions, including, in § 148.24(b), mandatory causes for terminating exemptions. Section 148.24(b) did afford the Director some discretion regarding termination of exemptions when the source of a release was a faulty well in the area of review, or a mechanical problem in the injection well itself. Finally, § 148.24(c) specified procedures which the Director must follow when terminating exemptions granted under § 148.20.

One commenter, supported by several others, noted that if EPA were to adopt alternative procedures for approving petitions (see comments in Section (II)(A)(1) of this preamble) any violation of the demonstration would constitute violation of the regulations and would, therefore, be enforceable within the context of these regulations. The commenter concluded that this section was, under the suggested alternative approach, unnecessary.

The commenter went on to say that under any approach, § 148.24(b) is unnecessary and should not be promulgated. According to this commenter, releases from the well or from an abandoned borehole can be fixed by relatively simple remedial action, and therefore should not be grounds for closing a well. Other commenters contended that any failure of the system should be grounds for automatic termination of the exemption whether or not these failures represented simple transient events that did not permanently compromise the system. Finally, some commenters objected to the procedural requirements associated with withdrawing an exemption, contending that it takes too long.

The EPA agrees that if the suggested alternative approach for implementing sections 3004 (f) and (g) were to be adopted, the requirements in §§ 148.23 and 148.24 could be addressed through enforcement. For the reasons outlined in Section (II)(A)(1) of this preamble, however, the Agency is not adopting any of these alternative approaches.

With regards to the grounds for termination, EPA believes that both comemnts have merit. Specifically, there are undoubtably circumstances when a simple failure of a well plug in an abandoned well or a well component in an injection well should not initiate closure or a redemonstration under § 148.20. On the other hand, the Agency believes that the Director should have the authority to cancel an exemption due to well failure or an improperly abandoned well in the area of review, in some cases. For example, instances of repeated well failures, or numerous problems with wells in the area of review, could indicate that the corrective action for wells in the area of review has been inadequate, or that the well is not functioning adequately to assure delivery of the waste to the injection zone. Under such circumstances, the Director should have the authority to revoke exemptions. Accordingly, the Agency believes the Director should have the authority to revoke exemptions for the above reasons, but should not be required to do so in all situations. Of course, in cases where the injection zone itself has allowed a release, or where the petitioner has willfully withheld information, the exemption must be terminated. The proposed rule provided this level of flexibility, and EPA is therefore promulgating the rule as proposed.

Finally, the Agency rejects the contention that the procedural requirements of § 124.5 are too slow when revocation is considered. The issues should be fewer than for petition approval, but will nonetheless benefit from full opportunity for public review and comment.

III. Summary of Today's Rulemaking: Response to Comments; Part 146, Subpart G

As outlined in the proposed rule, the Agency is establishing a new Supbart G applicable to owners or operators of hazardous waste injection wells. This section applies to all wells injecting hazardous waste, including those injecting wastes which are not yet prohibited, those which meet treatment standards promulgated under section 3004(m) of RCRA, and those whose waste has been banned under section 3004 (f) or (g) of RCRA and who have obtained an exemption pursuant to Part 148.

In the proposal, the Agency established a discrete section, Subpart G, which contained all Part 146 requirements applicable to injectors of hazardous waste. As indicated, much of Subpart G is merely a reorganization of requirements which were originally promulgated in June of 1980 (45 *FR* 42473 *et seq.*). It was not EPA's intent to solicit comment on requirements which existed by virtue of earlier rulemaking; rather, the Agency intended to simply recodify these existing requirements and solicit comment on the new requirements being proposed. The Agency nevertheless received comments on both the new and existing regulations. To the extent that these commenters sought substantive changes to the existing rules, the Agency has evaluated them, but, as explained in the proposal, does not believe we are under any obligation to make any changes. In all cases, the Agency will retain them and evaluate them in the context of any changes which it may

contemplate in the future, but the Agency does not believe it is under any obligation to address comments on existing regulations concurrent with decisions on this rule.

A. General Comments on Part 146

1. Stringency of the Regulations

Several commenters expressed general support for the reorganization of Part 146 requirements and the establishment of Subpart G. Many of these same commenters, however, believed that the existing Part 146 requirements were generally adequate to protect USDWs, and were not in need of substantial changes. These commenters suggested that added specificity, clarifications, updates, and some expansions were all that was warranted. In support of this, they noted that contamination of USDWs by injection wells has been rare, and has not occurred in a facility which is in compliance with existing UIC regulations.

Other commenters were supportive of the changes to Part 146, but opined that the changes did not go far enough. One commenter submitted instances of alleged contamination from injection wells in support of his belief that more stringent regulation of injection wells was required (Ref. 1).

The Agency has examined this report, two other reports conducted by contractors (Refs. 2 and 3), and analyzed the Agency's own Report to Congress performed pursuant to section 701 of the Hazardous and Solid Waste Amendments of 1984 (Ref. 4). Based on this analysis, the Agency cannot point to a body of instances which suggest that the existing regulations, and particularly as amended today, are not sufficiently stringent to protect USDWs. On the other hand, the Agency's experience in implementing the UIC regulations, as well as experience and knowledge gained from overseeing State implemented programs, together with information gathered during the section 701 survey, has enabled EPA to identify several important ways to improve the protectiveness of the original regulations. Many of these amendments are being made to address specific problems identified in one or more of the studies cited above. With these amendments, EPA has attempted to develop a set of regulations which provides a level of protection appropriate to wells injecting hazardous waste, yet one which is not unnecessarily burdensome.

2. Application of Part 146 to § 3004(b)(1)

In the preamble to Part 148 the Agency proposed to apply the amended Part 146 regulations to satisfy the requirements of section 3004(b)(1). This section prohibits the disposal of noncontainerized or bulk liquid hazardous waste in any salt dome, salt bed formation, underground mine or cave until: (1) The Administrator has determined, after notice of opportunity for hearings in the record in the affected areas, that such placement is protective of human health and the environment (section 3004(b)(1)(A)); (2) The Administrator has promulgated performance and permitting standards for such facilities (section 3004(b)(1)(B)); and (3) a permit has been issued under section 3005(c).

The Agency proposed that the amended Part 146 requirements could constitute performance and permitting standards for such facilities. The Agency also stated that a UIC permit, which qualifies as a RCRA permit-by-rule under § 270.60, would satisfy the permit requirement. Finally, EPA suggested that the hearing on the petition conducted pursuant to an exemption request under Part 148, could be held jointly with the hearing required under section 3004(b)(1)(A).

One commenter expressed strong support for this approach, but noted that for certain types of injection the UIC regulations either may not be appropriate or may need to be applied in a flexible manner. Specifically, injection of non-liquid fluids could require rules specifically tailored to the problems inherent to such injection. This commenter proposed specific changes to the UIC regulations which would make them suitable for regulating non-liquid fluids injected into salt domes. Another commenter expressed strong opposition to such an approach, stating that liquids dissolve salts, and thus salt formations are unstable and unsuitable for containment of wastes.

The Agency has historically regulated fluid injection into salt domes and salt beds under the UIC program. Under this scheme, a UIC permit issued under 40 CFR Part 144, Subpart D, would constitute part of a RCRA permit-by-rule under 40 CFR 270.60(b). For injection of liquid hazardous wastes, the EPA believes the framework outlined in the proposal is appropriate, and will largely follow those procedures when permitting injection of liquid hazardous waste into salt domes and salt beds.

A recent final rule, Subpart X of RCRA (52 *FR* 49946 *et seq.*, December 10, 1987), addresses regulation of certain unconventional disposal practices, including, under some circumstances, injection of non-liquid hazardous fluids. This rule also outlines in detail the relationship between Subpart X requirements and the UIC permitting. Briefly, Subpart X provides the Agency a flexible permitting scheme that may be applied to hazardous waste disposal when existing standards are inapplicable. It is premature to discuss specific features which would make the application of Part 146 standards inappropriate. Such determinations will be made in the context of a facility's permit application.

On the technical point concerning the solubility of salt formations, it is common knowledge that salt dissolves in water. However, salt will not further dissolve once the water is saturated. In such situations hollowed out salt domes have an excellent combination of high plasticity and low permeability to seal against the migration of hazardous wastes. Thus, EPA believes such disposal technology to be promising. The acceptablity of a facility, of course, must be evaluated on a site-specific basis.

The Agency has decided that rather than amending the UIC requirements to suit non-conventional underground emplacement of waste as the one commenter suggested, it will rely on the authority in new Subpart X to develop an appropriate set of requirements in the permit. As noted in the preamble to Subpart X, the decision on whether to regulate unconventional injection operations under the UIC program and/or Subpart X is a case-by-case determination (52 *FR* 49953). A more complete discussion of the relationship between the UIC program and the Subpart X requirements is provided in that rulemaking.

B. Applicability—Section 146.61

Section 146.61 proposed, in part, new definitions applicable to Class I hazardous waste injection. A number of commenters addressed this section.

One Commenter favored codifying in Part 146 the term "injection interval", also codified today at § 148.2. The Agency believes that this term is most applicable to facilities petitioning for an exemption under Part 148, but believes that the term has utility in the context of certain Part 146 requirements. Consequently, EPA is today codifying the term "injection interval" at §§ 148.2 and 146.61(b).

A number of commenters were concerned with the new term "cone of influence". This definition, and its relationship to the new Area of Review

requirements, has been addressed in Section (III)(D) of this preamble.

Finally, there were many comments received on the redefinition of the term "existing well", as it applies to hazardous waste injection. It was the Agency's intention, in redefining this term, to insure that the owner or operator of an existing authorized well not be subject to those requirements at § 146.65 which are applicable only to new wells not yet constructed. Two commenters wanted this definition changed to include wells already authorized to receive non-hazardous fluids, noting that such non-hazardous fluids could eventually be classified as hazardous.

Provided that an already authorized, non-hazardous injection well can safely inject hazardous waste, the Agency agrees with the contention that such wells should not be classified as "new wells" in the context of this regulation merely because the definition of the waste they are injecting changes. EPA can foresee a situation where a permitted Class II or III well would become a hazardous waste injection well by virtue of changes in the definition of "hazardous". If such a well is able to meet all other applicable 146 and 148 requirements, it should be classified as an "existing well". Today's promulgation of the term "existing well" allows such a situation.

Another commenter wanted this term to include any Class I well "permitted, authorized, or constructed" prior to the effective date of this rule, whereas the proposed definition included only "authorized". Per §144.11, any well which is permitted is automatically authorized. Consequently, there is no reason to include the word "permitted" in today's redefinition of "existing well". Section 144.11 states that, "The construction of any well required to have a permit is prohibited until the permit has been issued." Class I hazardous waste injection is a permitted activity, consequently any proposed hazardous waste injection well must receive a permit before well construction begins. The situation indicated by the commenter above proposes to include constructed, but unauthorized, wells in the spectrum of "existing wells". The Agency's legal position is that such a well is illegal under the terms of the UIC regulations, § 144.11.

Two other commenters wanted "existing well" redefined to include wells not yet completed whose permit applications have been submitted and are under review, or existing wells whose permits are on appeal. Existing wells whose permits are under review automatically receive an authorization by rule, pursuant to §§ 144.21 or 144.22. Section 124.16 states that, for a new facility or new injection well, "* * * the applicant shall be without a permit for the proposed new facility * * * [or] * * * injection well . . . pending final Agency action." In this instance, the well will not have been constructed yet. Under these circumstances, EPA strongly urges the applicant and—in the case of primacy states where the amended requirements have not been adopted—the Director, to construct or require the well to be constructed according to the standards applicable to new wells.

C. Siting Requirements—Section 146.62

In the proposal, the Agency stated more explicitly requirements which had been stated very broadly in the existing regulations. In the proposal, criteria which had previously been framed as factors which the Director had to "consider", were expressed as specific requirements which the owner or operator had to meet. Several new, substantive requirements were also added.

In the proposal, the regulations at § 146.62(a) restated existing language which required that all Class I wells be sited beneath the lowermost USDW; § 146.62(b) restricted siting to areas that are geologically suitable, and defined criteria describing such areas; § 146.62(c) specified performance standards for the confining and injection zones; § 146.62(d) outlined additional requirements which would provide an additional degree of assurance that the waste would be adequately contained or that the site would not otherwise endanger USDWs.

1. Need for Additional Siting Requirements

Nearly all commenters supported the clarification of existing siting requirements, but several maintained there was no need to add more explicit siting requirements or standards. These commenters believed that absence of contamination incidences suggested no changes were necessary.

The Agency disagrees. The EPA identified several important criteria which it believes significantly improve the protectiveness of the siting requirements. The UIC program as mandated by the SDWA is preventative in nature, and to the degree that these improvements do not impose unnecessary new burdens on the owner or operator, EPA believes it appropriate to promulgate them.

2. Consideration of Seismicity in Local Geology

Two commenters suggested that § 146.62(b)(2), which lists parameters to be considered when evaluating local geology, include consideration of the seismic history of the site. The proposed rules, at § 146.62(b)(1), required consideration of seismicity on a *regional*, not local basis. The Agency intends to retain the requirement as proposed for several reasons. First, the United States Geologic Survey (USGS) at the request of EPA, recently completed a study on potential earthquake hazards associated with injection wells (Ref. 5). That report recommended *regional* evaluations of tectonic stress as a critical part of site evaluations. The Agency believes that concerns of a more local nature, if any, are better addressed by a monitoring program. A more comprehensive discussion of the USGS report and the role of seismicity in siting and operating injection wells is provided in Section (III)(I)(6) of this preamble.

3. Geologic Criteria

Several commenters objected to the requirement in § 146.62(b)(3) which required that the site be capable of being modeled accurately. These commenters noted that precise predictions of the location of a plume or a pressure front are not necessary; rather, the modeling must be capable of bounding the problem.

EPA agrees. The intent in this section was to be sure that the geology of the site was not so complex that modeling would not provide meaningful results. The Agency was concerned that the complexity of the site not outstrip the technology available to model it. Accordingly, the language is being revised to address this specific concern.

4. Standards Applicable to the Injection and Confining Zone

Section 146.62(c) of the proposal contained performance standards which the confining zone would have to meet. This section required that the confining zone be laterally extensive and free of transmissive transecting faults over an area sufficient to prevent movement of fluids into a USDW. In addition, this section would have required that the confining zone contain at least one formation of sufficient thickness and with lithologic and stress characteristics capable of preventing vertical propogation of fractures.

There was extensive comment on this provision. Most objected to the requirements as stated, maintaining that the two provisions were redundant. On

the other hand, one commenter, supported by several others, contended that the presence of any fault should preclude siting an injection well, regardless of whether that fault had the capacity to transmit fluid to overlying zones. They suggested that such faults made accurate modeling impossible. These same commenters suggested that EPA should specify a minimum thickness and permeability which the confining zone must meet and further, that these parameters be measured only in the formation directly adjacent to the injection zone.

The Agency agrees that §§ 146.62(c)(2)(i) and (ii) address similar concerns, but does not believe this suggests that one or the other requirement be deleted, as the commenter maintains. It is a common practice in engineering to build safeguards into systems, particularly where uncertainty may exist, or where the consequences of error are significant. Thus, EPA does not believe that the logical consequence of finding that these requirements overlap is to delete one or the other of them. Rather, the Agency believes these requirements to be complementary; together providing a level of assurance consistent with the mandate of the SDWA and RCRA.

Pertaining to the commenter who suggested specific numerical requirements applicable to the confining zone, EPA would like to note that precisely that option was examined during the course of regulatory negotiations. As outlined in the preamble to the proposal (52 *FR* 32456), the factors which define an acceptable site are often qualitative. Specifying a set of quantitative values outside the context of the myriad other factors that must be considered in siting decisions would not be effective. To be workable in all cases, these values would have to be so restrictive that safe sites would be prohibited, or the rule would have to provide the option of allowing the Director the authority to waive them when not necessary or appropriate. The Agency believes that it is better to allow consideration of qualitative factors such as the plasticity of the rock, the type and amount of clay in the confining zone, the relative difference in permeability between the injection and confining zone, the seismicity of the area, the characteristics of the injected and formation fluids, the relative pore pressures, the depth of the injection zone, and a host of other factors as they relate to defining adequate siting in the first instance.

Finally, one commenter apparently believed the Agency was somehow trying to restrict the orientation of any fractures developed during well stimulation. This commenter pointed out that below certain depths fractures form on a vertical axis. In response, EPA would like to note that § 146.62(c)(2)(ii) pertains to the confining zone, not the injection zone. Moreover, this section is meant to deal with the vertical *propagation* of fractures, not their vertical orientation. The existing rules allow fracturing of the injection zone during well stimulation, and EPA recognizes that these fractures, below certain depths, will be oriented (but not propagated) vertically. Nothing in today's rule alters or attempts to alter the physical fact of a fracture's orientation, or the operator's right to stimulate the well. The purpose of § 146.62(c)(2)(ii) is to be sure that at least one formation has the right mix of thickness and plasticity to prevent a fracture from moving up (that is vertically propagating) through the stratigraphic column.

5. Additional Safeguards

Section 146.62(d) outlined four safeguards, one of which the owner or operator would have to demonstrate to the satisfaction of the Director that his site shared. They included (1) a showing that a "buffer" aquifer/aquiclude system was present between the confining zone and the base of the lowermost USDW or (2) a showing that within the area of review the piezometric surface of the fluid in the injection zone was lower than the piezometric surface of the lowermost USDW or (3) a demonstration that there was no USDW present or (4) that the geology, nature of the waste, or other considerations would not allow an undiscovered conduit to endanger a USDW.

As stated in the proposal, the goal of § 146.62(d) was to deal with the uncertainties which some members of the regulatory negotiation committee believed were inherent in characterizing geologic conditions in the subsurface. These requirements were intended to either eliminate the uncertainty involved in characterizing subsurface geology, or the consequences of failing to identify a breach in the confining zone, be it a man-made conduit or a natural transmissive fault or fracture.

Several commenters objected to the requirement for additional safeguards in general, and the need for a "buffer" aquifer/aquiclude system between the top of the confining zone and the base of the lowermost USDW in particular. They noted that the existing siting requirements, particularly when considered with those proposed in § 146.62(c), in conjunction with the Area of Review requirements and Corrective Action requirements in §§ 146.63 and 146.64 respectively, adequately addressed concerns about abandoned boreholes or improperly completed wells. One commenter suggested that since § 148.20 required the presence of an arresting layer within the injection zone, and § 146.62(c)(2) specified minimum standards for a confining zone, this provision effectively applied a third layer of redundant protection to the siting requirements. The commenter believed this level of regulation to be excessive.

The Agency agrees that the AOR and Corrective Action requirements being promulgated today address any conceivable set of concerns which might arise with respect to abandoned or improperly completed wells within the area of review. However, the EPA would like to note that the requirements in § 146.62(d) were meant to address more than just abandoned boreholes; they were also meant to address concerns relating to the geology of the site such as fractures or faults. While EPA does not believe that uncertainty is "inherent" in characterizing geology—given the improvements in remote sensing, techniques of stratigraphic correlations, and borehole logging—the Agency does believe that additional safeguards are appropriate. These safeguards address not only problems which might arise from an undiscovered fault, but also problems which could arise from improper operation. Finally, EPA would like to reiterate that overlapping safeguards are a sound and frequently applied principle of good engineering. The fact that one set of requirements addresses a particular concern does not and should not preclude application of other rules which also address the concern.

The commenter who thought that EPA was applying a "third layer of protection" beyond those required in Part 148 and § 146.62(c), apparently did not understand the relationship between Part 148 and Part 146. First, Subpart C of Part 148 does not apply to all hazardous waste injection wells. Wells which inject waste which meets, or has been treated to meet, levels specified in 40 CFR Part 268, are not subject to the "no migration" provisions in § 148.20.

Second, and more important, the two rules apply complementary, but different standards. Part 148 applies a "no migration" standard, while Part 146 is designed to assure no endangerment of USDWs. The standards in § 148.20 were developed to assure that no *injected waste could leave the injection zone.* Part 146 is meant to assure that there will be no endangerment of USDWs,

either from injected fluid *or formation fluids.* With respect to injected fluids, the standards in 148 are certainly more stringent since they prohibit migration of any injected waste at hazardous levels out of the injection zone. However, endangerment encompasses a broader set of concerns and therefore warrants a broader set of regulatory controls. For example, the area in which *formation fluid* could endanger USDWs is described by the pressure front induced by injection; the area in which *injected fluid* could move out of the injection zone, on the other hand, is described by the size of the waste plume. The pressure front is always larger—usually much more so—than the waste plume.

Accordingly, EPA believes it is a mistake to construe that the requirements of § 148.20 are equivalent to those being applied in § 146.62. They do not address the same universe of wells, nor do they address the same concerns. The Agency, therefore, rejects the notion that the two rules are redundant and result in an unnecessary third level of protection.

A number of commenters objected to the provision in § 146.62(d)(4) which provides the Director the authority to approve a site which lacked one of the specific safeguards outlined in section (d) (1), (2), or (3), but which otherwise could show a comparable level of safety. Most commenters, however, expressed strong support for the provision. In criticizing the safeguards outlined in the previous three paragraphs, commenters frequently pointed out scenarios in which the certainty of characterizing the site accurately was extremely high, and therefore the need for redundant safeguards low or non-existent. These commenters noted that in some areas, drilling or other exploration has been extensive enough to provide extremely accurate pictures of the geology of the area and regulatory controls have been in place and adequately assure that abandoned boreholes have been located and plugged. It was such circumstances the Agency sought to address when proposing § 146.62(d)(4).

Commenters who objected to this provision seemed to believe that EPA was subjecting operators to a lesser standard in § 146.62(d)(4) than in the other three sections. As one such commenter expressed it, "EPA has proposed a broad exception to the siting criteria * * *". These commenters are apparently confusing the need for a safeguard, where doubt exists, with the standard itself. This section is not an exception to the siting standard. It provides another means by which the standard may be met, another way in which uncertainty may be resolved.

At the heart of this comment appears to be the contention that any and all attempts to describe geology are inherently flawed. The Agency rejects this contention, and accordingly will promulgate this section as proposed.

Finally, some commenters were concerned that this latitude might be abused by those implementing the UIC program. The EPA notes that all permit decisions are subject to rigorous public participation requirements. If, in an individual case, a State Director exercises the discretion afforded him too broadly, the public will have ample opportunity to comment, and, if necessary, challenge his decision. If such an abuse is systematic, EPA will take appropriate action as part of the Agency's oversight responsibilities.

D. Area of Review—Section 146.63

One of the key changes proposed for the Class I regulations was the expansion of the area of review (AOR). The AOR pertains to the area within which the owner or operator must identify all wells penetrating the confining zone and the injection zone and determine whether they have been properly completed or plugged and abandoned. In existing UIC regulations it is defined either by a fixed radius of ¼-mile from the well bore or by a calculated "zone of endangering influence." As a result of the information gathered during the § 701 survey of hazardous waste injection wells, concerns raised by the regulatory negotiation committee, and information developed from recent research on well failures, EPA proposed to amend the area of review requirements for hazardous waste injection wells by extending the area to be examined for abandoned or improperly completed wells to an area with a radius of 2½ miles from the injection well bore or, in some circumstances, the calculated "cone of influence" of the well.

The "cone of influence" defines the area of review as the area described by the incremental increase in pressure caused by the injection well. The Agency believes that the pressure of concern should be the increment over background, static pressure conditions since that is the pressure resulting from the regulated activity.

1. Increase in the Size of the Area of Review

The Agency received many comments on the proposal to increase the size of the area of review.

Several commenters indicated that the 2½-mile area of review was unnecessarily large and would require the well operators to conduct lengthy record searches that are time-consuming and costly, possibly even precluding the drilling of Class I injection wells in the very cases where geologic data was most reliable. In addition, other commenters stated that the proposed area of review was totally arbitary with no technical basis and that using a calculated cone of influence for the well was adequate, especially if the calculated area was substantially less than the 2½-mile minimum requirement.

In reply, the Agency notes that recent studies on the consequences of well failures suggest that the single most significant potential source of contamination from injection wells would be an unplugged borehole within the area of review where there exists a pressure sufficient to drive fluids up the borehole (Refs. 6 and 7). EPA also notes that the State of Texas which specifies a 2½-mile AOR, and the State of Louisiana, which specifies a 2-mile AOR, currently regulate over 60 percent of the wells injecting hazardous waste. These States do not give exceptions to their area of review requirements, therefore enlarging the area of review does not significantly increase the burden for the majority of operators. Even where there is an increase in burden, the Agency believes that the special characteristics of hazardous waste injection warrant a margin of safety more stringent than for other wastes. The Agency believes that a larger fixed radius is not capricious or without some technical basis, as our research in abandoned well studies indicates (Ref. 6 and 7). Also, during the course of regulatory negotiation, State regulators noted that an area of review between 2 and 2½ miles represented an appropriate maximum radius based on their field observations of hundreds of injection wells. However, the Agency believes the intent of the enlarged area of review can be met adequately with a 2 mile minimum, rather than a 2½-mile area of review. The 2-mile area of review has the advantage of not disrupting existing state programs of substantial size. Under today's rule, the Director will have the authority to enlarge the area of review beyond two miles if he has reason to believe that a larger area of review is necessary.

2. Calculation of the Area of Review

Many comments were received concerning the calculation of the area of review. One commenter believed that the area of review should be fixed at the 2½-mile radius value for all wells and not calculated as there appears to be too

much confusion on how to calculate an area of review. In contrast, another proposed that the area of review should have a 10-mile fixed minimum radius from the injection well and expressed a lack of confidence in a well operator's ability to either model or calculate the cone of influence. Accordingly, they believed the 2½-mile minimum requirement was not restrictive enough.

The Agency has confidence in the mathematical calculations for the cone of influence. Pressure buildup is well understood, and the effects of injection can be accurately identified. There may very well be sites where a calculated area of review in excess of 2 miles is indicated. For such sites, today's rule would provide the Director with the authority to require an AOR in excess of 2 miles. However, a 10-mile radius minimum area of review is extremely large and to prescribe for every injection well such an AOR would place an unnecessary burden on both the well operator and the regulatory agencies conducting the review, without adding further protection to the environment.

One commenter suggested that the area of review should only be tied to waste plume migration rather than calculated from reservoir pressure.

EPA would like to note that the primary concern which § 146.63 addresses is the endangerment of USDWs, regardless of whether that endangerment would result from highly mineralized brines in the injection or intervening formations, or from the injected waste stream. In all cases, an area of review based on the waste plume would be significantly smaller than one based on the pressure increase during the operational life of the well, and would therefore not prevent endangerment. Moreover, the long term concerns associated with plume movement after the well is plugged, are addresed in the modeling performed under § 148.20. Accordingly, EPA will continue to base AOR on pressure buildup.

A few commenters indicated that the language proposed by the Agency for the determination of the area of review was unclear and suggested that the Agency provide one method of calculating the area of review to serve as a guidance for all affected states. Finally, some commenters were concerned that one interpretation of the regulation could require a calculated area of review which extends indefinitely in order to satisfy the reviewing regulatory agency. These commenters suggested that such a calculated infinite area of review should be spatially limited by the Agency to avoid this potential problem.

The Agency believes that a guidance may be necessary to clarify the methods appropriate for establishing area of review, but does not believe that a single calculation, or a set of calculations, describes the universe of acceptable methods for determining area of review. Moreover, prescribing by regulation the appropriate method could preclude permittees from using more sophisticated methods which might become available at some future point. Therefore, the Agency is not specifying particular methods of calculating an area of review in this rule.

The Agency also recognizes that calculations may result in an asymptote, or that in some physical settings the formation pressure will contribute to an AOR that extends over great distances. Under current State and Federally-implemented rules, the problem of infinite asymptotes has been addressed by setting cut-off points when the slope of the pressure curve flattens. It is not EPA's intent that operators "chase asymptotes" when no real potential endangerment resulting from the well exists. The physical settings which might result in calculated AORs in excess of 2 miles involve highly overpressurized formations. As noted in the proposal, overpressurization can be evidence that the formation is effectively a closed system. Where natural or man-made points of discharge exist, pressure will begin to equilibrate, and the excess pressure will tend to "bleed off". Absent such leaks, the system will retain excess pressure. Moreover, such systems are more likely to be static, resulting in very little or no flow over time. Accordingly, EPA still believes the appropriate AOR is described by the pressure from the well injection, and further believes that in the vast majority of cases, that this area is described by a 2-mile area of review.

Accordingly, the Agency is now specifying in today's rule, a fixed 2-mile minimum area of review. But in recognition that in some circumstances an area of review may be greater than 2 miles, the Director has the discretion to require a larger area of review. One such reason may be the cone of influence, which must still be calculated and provided by the owner or operator to the Director for his determination of whether corrective action would be required for abandoned or improperly completed wells.

E. Corrective Action for Wells in the Area of Review—Section 146.64

The Agency proposed additional corrective action requirements and proposed reorganization and consolidation of the current regulations as §§ 146.64 and 146.70 in Subpart G. In general, as proposed, § 146.64 states the requirements for corrective action and § 146.70 outlines the information required to show compliance with them. The following response concerns comments received for corrective action requirements in § 146.64.

1. Application of the Area of Review

Under existing regulations, the owner or operator must submit a plan concerning the steps taken to address improperly completed or abandoned wells within the area of review, but he is not required to submit a protocol for identifying all wells within the area of review. The Agency proposed to require that an owner or operator submit such a protocol to the Director outlining how he intends to identify all wells within the area of review, and how he intends to determine whether these wells have been adequately completed or plugged. The Director would be required to review the plan, determine whether it is adequate, and either approve it, modify it, or deny the application.

An approximately equal number of commenters supported and opposed this proposed amendment. Several commenters specifically indicated that corrective action should be limited to only the wells within the cone of influence, not the proposed 2½ mile radius area of review. Some commenters also cited the problems, both legal and logistic, associated with wells located on property not owned by the applicant as a reason to limit the scope of corrective action. The Agency will not, however, require corrective action on wells within the area of review if it can be effectively demonstrated that there is no potential to move fluids through a conduit. In response to the first concern, it is EPA's intent to assure that all wells within the area of review are identified and evaluated. EPA would like to note that in some cases, some wells outside of the cone of influence may have to be evaluated in a petition demonstration under part 148; for example, where the formations are naturally overpressured and where there is significant flow.

One commenter also contended that corrective action requirements were not feasible in many cases because the operators could not compel other owners of wells off their property to fix wells. The existing rules allow the applicant an alternative to fixing these off-property wells. If the cone of influence is very large or if the applicant cannot access improperly plugged or abandoned wells outside of his property, he may seek from the Director permission to reduce the area within

which wells must be fixed by reducing pressure and thereby satisfying corrective action requirements. This provision is merely a restatement of existing requirements. As such, the Agency is neither seeking comment, nor anticipating making any changes, such as allowing pressure limitations at the discretion of the operator, as one commenter seeks. EPA believes that the issue of when pressure limits may be used in order to satisfy corrective action should be at the Director's discretion. The Director may choose to limit its use, for example, in a case where the operator has violated pressure limitations in the past. Pressure limitations, however, are not the preferred means of meeting corrective action and EPA will limit its uses to cases where the Director deems it appropriate.

2. Abandoned Well Protocol

The greatest number of comments received concerning corrective action addressed the information and substance required in the protocol for identifying wells in the area of review. Several commenters were of the opinion that the Agency should indicate the necessary steps to establish such a protocol, the information to be contained in a protocol, and the specific requirements concerning the search methods for abandoned wells. Some commenters felt that the specific methods of abandoned well searches should be indicated while at least one commenter argued that, except in unusual cases, it was inappropriate for an applicant to use any methods other than a search of public records provided by local, state, and federal agencies. In any case, one commenter also felt that once wells were identified, the evaluation of wells merely penetrating into the confining zone was unnecessary and such evaluation for corrective action was unwarranted.

In general response to these comments, the Agency believes that a technical guidance may be necessary to further explain protocol requirements. However, the Agency also believes, particularly in cases where public well records are poor or non-existent, that just a cursory search of well records is inadequate where hazardous waste injection is concerned. Furthermore, EPA also believes that the time to evaluate well search methodology is prior to the initiation of the search and not after. The Agency plans to issue a UIC guidance on this protocol in the near future.

Finally, EPA believes that it is necessary to look at all wells penetrating the confining zone in order to determine if a problem could develop by the reduction of thickness of the confining material caused by such penetration. The evaluation of these wells does not compel corrective action unless the integrity of the confining zone is compromised. Therefore the review necessitated by this possibility is exactly what the Agency is requiring in the regulations and the regulations will be promulgated as initially proposed.

F. Construction Requirements—Section 146.65

The amendments for construction requirements reflect the Agency's attempt to achieve an appropriate balance between specific design standards and more general performance standards. Current regulations describe a very broadly structured performance standard and list specific factors that the Director must consider when evaluating the construction of a well. As a result of the Agency's consideration of historical well construction practices within states, the section 701 report to Congress, and the need for a more clearly defined set of standards, the Agency is increasing the specificity of the construction requirements and adding some new requirements.

The changes in construction requirements outlined in § 146.65 include: additional criteria in overall performance standards; more explicit compatibility requirements; and certain requirements for owners and operators injecting through a well equipped with fluid seals. In addition, § 146.65(c)(1), which addresses requirements for new wells, contains a more specific articulation of the performance standards outlined in § 146.65(a)(1).

1. General Construction Concerns

There appeared to be general support for the requirements outlined in § 146.65(a). One commenter indicated support for requiring wells to be constructed to allow the use of appropriate testing devices and workover tools. Another commenter indicated that in § 146.65(a)(3), injection "tube" should be changed to injection tubing. The Agency has made the correction.

One commenter, supported by several others, objected to the requirement that new wells be constructed in a manner that allowed the use of appropriate logging and testing devices. This commenter contended that the best means of preventing a future leak was to assure proper construction of the well in the first place. The commenter went on to suggest that allowing the design and construction to be dictated by testing requirements could be counterproductive.

The Agency rejects this argument. The commenter apparently assumes there are instances when the considerations pertaining to proper construction and those associated with the ability to adequately test the well are mutually exclusive. The Agency is stating that both goals, proper construction and the ability to adequately test the well, are legitimate and complementary aims that must be considered during the construction of a new well.

2. Well Materials and Compatibility Requirements

For the section concerning well compatibility requirements, a number of commenters indicated that a published standard for the materials used in well construction, and their compatibility with the wastes, may not exist. Also, they were of the opinion that a well operator should not be deemed in violation of a permit based on material standards since these standards are usually developed for new materials and generally do not apply once the material is placed in service in a well. The Agency has indicated in this regulation that in cases where an operator chooses to use an exotic well material for which no published or recognized standards exist, comparable standards acceptable to the Director would need to be developed. Therefore, the owner or operator does have this provision as an option to a bonafide American Petroleum Institute (API) or American Society of Testing Methods (ASTM) or other published standard. The Agency is also cognizant that well materials may deteriorate with use and time, but notes that published standards generally specify limits which are acceptable during the service life of the material, not merely upon installation.

3. Casing and Cementing

There were several comments pertaining to the casing and cementing of new wells. One commenter suggested deletion of the requirement that surface casing must extend below the lowest formation containing a USDW. EPA rejects this suggestion. The Agency has determined that having two strings of cemented casing, the surface and long string casing, affords significantly greater protection to USDWs than a single string of cemented casing.

Another commenter sought a specific prescribed depth of penetration by the surface casing into the confining bed below the lowest formation containing a USDW. This is a site-specific issue and should be established in the context of

permitting. One commenter also informed us that in the arctic, the section of the annulus through the permafrost must be filled with a non-freezing fluid to prevent collapse of the long string casing. Circulation of cement to the surface upon setting the casing is therefore precluded in these cases. The Agency acknowledges this problem and notes that § 144.16 allows the Director discretion in approving alternative cementing programs where no USDW exists, as is the case with the commenter's well. Moreover, § 146.65 allows the Director to approve alternatives even where a USDW is present.

The Agency also requested, in the proposed rule, comments pertaining to the 120% of calculated volume of cement required to be circulated to the surface when setting casing. In particular, EPA sought comment on whether more than 120% of the calculated volume should be required. Most of the commenters responding to our request for information replied that the 120% cement volume figure was sufficient, although some believed it to be inadequate, and others excessive. In consideration of this response, the Agency believes that this minimum amount of recirculation is adequate in most cases. However, EPA has incorporated new language in today's rule which would allow the Director to require more, not less, than 120% cement in excess of calculated hole volume if he determines that geologic and construction conditions warrant such an increase.

4. Mechanical Packers and Fluid Seals

The last section of § 146.65 concerns tubing, packer, and fluid seals. The greatest number of commenters in this section sought a change in the proposed language of the requirement that the packer be placed above the injection zone. The Agency agrees that in many cases it is indeed preferable to set the packer either at the top of, or within, an injection zone, and also that some flexibility in the placement of the packer during the life of the well is needed. Therefore, EPA has included new language in this section which will allow the packer to be located as approved by the Director.

A few commenters were of the opinion that the design standard which proposed that testing and monitoring requirements for fluid seals be as stringent as those for wells constructed with tubing and packer was excessive. The Agency disagrees and believes that these requirements are justified in light of the complexity of the application and maintenance of fluid seals in general. The Agency continues to be of the opinion that the simplicity of the mechanical packer is preferable in most cases. However, § 146.65(d)(3) would allow the owner or operator to install a fluid seal provided he demonstrates to the Director that the fluid seal will provide a level of protection equal to or exceeding that which a packer-equipped well would provide. Many commenters supported our allowance of fluid seals, and contended that such seals could provide protection superior to packers.

G. Logging, Sampling, and Testing—Section 146.66

The requirements pertaining to logging, testing, and sampling have been consolidated into § 146.66 in today's rule from existing §§ 146.12(d) and 146.14(b). In addition, the Agency is changing the requirements in several important ways. As indicated in the August 27, 1987, proposed rule, these requirements apply only to new hazardous waste wells.

The first change in the regulations defines the goals of this section. The establishment of baseline data prior to injecting against which future logging and testing can be reassessed is an important new use of data. The Agency believes this to be an important concept: the future utility of many logs is dependent on having base logs against which to compare. Therefore, the operator's ability to demonstrate compliance at some future time may depend on what logs he ran when the well was first constructed. EPA believes that detailed logging prior to injecting can be of benefit to both the regulator and the permittee.

Another change proposed involved the tests required both before the casting is set and after it is in place. The wording in existing § 146.12(d)(2) was unclear in regard to whether all of the tests outlined were mandatory or only one subset was needed. The language in today's § 146.66 clearly indicates that all of the listed tests must be conducted. This regulation also reflects the concern of some members of the regulatory negotiation committee that the technologies used to test wells were rapidly evolving and that by allowing the Director to approve an equivalent alternative, improved tests would not be eliminated from consideration. Thus the language in this regulation allows the Director to approve an alternative or additional test when he deems it appropriate. The Agency is also effectively changing the mechanical integrity requirements in § 146.68(d). Now an initial demonstration of mechanical integrity for new wells must be made as indicated in current § 146.66(a)(3). A more detailed discussion outlining the Agency's rationale for more stringent MIT requirements is found in the section of this preamble which addresses § 146.68, Testing and Monitoring Requirements.

Although pre-existing regulations in § 146.12(a)(15) require the Director to evaluate an operator's coring program prior to the granting of a permit, this provision did not place a burden on the Director to require coring, or on the operator to conduct it. Also, EPA wanted to provide the Director the authority to require coring of formations other than the injection and confining zones. The Agency maintains that the relatively inexpensive task of coring is justifiable in view of the information it provides. Today's rule states the coring requirement more prescriptively and affords the Director the authority to require cores from other formations. The Agency believes, however, that the situations in which the Director would want to require coring of formations other than the injection or confining zones should be relatively rare.

Another change now requires the owner or operator to conduct pump or injectivity tests to identify the hydrogeologic properties of the injection zone through an empirical method. These tests have the advantage of yielding an aggregate figure which represents an entire stratum or several strata. The original regulations required the Director to "consider" the owner or operator's formation testing program, therefore the Agency does not see this restated requirement as a substantive change.

In § 146.66(f), the Agency proposed language which would assure that the Director has the opportunity to witness logging or testing procedures by requiring the permittee to submit a schedule of testing activities at least 30 days prior to conducting the specified tests.

1. Coring

The greatest number of comments pertaining to the § 146.66 requirements concerned coring. Many commenters indicated that coring was prohibitively expensive to the owner or operator. Some were concerned that sidewall or continuous cores could not always be retrieved from certain formations in the well bore. Other commenters indicated that the information sought from cores could be obtained from adjacent well cores if it could be demonstrated that the zones of interest were correlative in each well. The remaining comments on coring challenged the Director's authority for requiring coring from formations other than the injection or

confining zones. As we have already stated, the Agency believes that the information obtained from coring justifies the expense. Also, EPA is not requiring coring in existing wells, only in newly drilled wells. The Agency agrees that continuous core retrieval is not always possible, but sidewall cores are usually recoverable and are acceptable.

As noted in the proposal, if EPA were to limit its ability to collect relevant data, the Agency might be placed in the position of having to turn down an otherwise approvable site simply because adequate data wasn't available. In particular, flexibility in siting requirements is dependent on the extent of data available. Today's rule will contain language which would allow the Director discretion in accepting core information from nearby wells in the few cases where core retrieval was impossible in a newly drilled well.

With regard to requiring cores and other logs from formations other than the injection and confining zone, EPA disagrees with commenters who maintain that it is unnecessary. Section 1422 of The Safe Drinking Water Act is preventative in nature. The UIC regulations are designed to prevent endangerment of USDWs regardless of whether that endangerment results from highly mineralized formation fluids, or from injected wastes. Thus, the Agency can envision circumstances when it will be necessary to obtain data on strata lying between the lowermost USDW and the confining zone to assure that such endangerment is not occurring.

2. Data Collection Requirements

There were numerous comments to the proposed rule pertaining to the requirements for individual logs and other data collection procedures. Several commenters believed that information collection requirements relating to this section of the regulations should not be arbitrarily applied to zones other than the injection and confining zone. As EPA indicated in the earlier proposal and mentioned in the comment response to coring operations, the Agency believes that it is not being arbitrary in requiring certain types of information from other formations penetrated by the well. EPA believes that the statute and regulations require that such information be considered. The regulations now contain a provision which would necessitate information gathering on the formation immediately below the lowermost USDW. For these reasons, EPA believes it necessary to have the authority to require information on the formations found in the wellbore, including logging, coring, testing, and formation fluid sampling, other than the injection and confining zones alone. Therefore, we are promulgating this requirement as proposed.

3. Logging Tool Concerns

One commenter indicated that the language in the proposed regulation concerning deviation checks should be rephrased to indicate that this type of procedure was performed during and not after the drilling of the well. The Agency agrees and an appropriate language changes has been made to eliminate any confusion on this procedure. Several commenters questioned the utility of the Fracture Finder Log and also indicated that the language in the proposed regulation could be interpreted as indicating that this log was to be run after and not before setting a casing string. The Agency believes that a Fracture Finder Log is very useful in determining the presence or absence of fractures in close proximity to the well bore and is an essential part of ensuring that all necessary data regarding fractures in the injection, confining, or other relevant formations has been collected. This log also helps establish strike and dip, which can be invaluable in characterizing stratigraphy. Therefore, the Agency will continue to require this log for all newly constructed wells. However, the Agency has rephrased § 146.66(a)(2)(ii)(B) to clearly indicate that this log should be run prior to setting casing. The language also allows the Director the discretion to waive this log requirement where he determines that other information would suffice, or where the application of this log, such as in unconsolidated sediments, has proven to be ineffective.

Several commenters pointed out that there could be some confusion by owners or operators in the terminology of "density log" as used in § 146.66(a)(2)(i)(B) and § 146.66(a)(2)(ii)(C). The Agency is aware that the required log is not an open-hole formation evaluation density log, but rather a variable density log run in conjunction with a cement bond log or other cement evalution log. The appropriate terminology has been inserted in today's rule.

One commenter indicated that the proposed rule in § 146.66(d) requires only a calculation of the fracture pressure of the injection and confining zones. The commenter maintained that such calculations were subject to uncertainties of 10% or even more. In view of this, they suggested that only a direct measurement should be accepted. The Agency's study pertaining to earthquake hazards and seismicity (Ref. 5) indicates that the most reliable method of making such measurements is by direct methods, such as hydraulic fracturing. However, the Agency believes that in some cases, the Director should have the discretion to accept equivalent methods or calculations, or to rely on existing data. For example, in many cases there exists a substantial body of historical information which will enable fracture pressures to be calculated with great precision. In such instances, EPA believes that the Director should have the discretion to accept such calculations, and is therefore promulgating the rule as proposed.

4. Witnessing of Logging and Testing Procedures

Finally, several comments were received concerning § 146.66(f), which gives the Director the opportunity to witness all required logging and testing. All of these comments stated that the 30-day notification by an operator to the Director prior to the first test or log was too long, and that a 24-hour, or at most a few-day prior notification period was adequate. They indicated that often last minute changes occur which could render the schedule maeaningless. The Agency is simply requiring that the Director be provided with a schedule of planned logging, coring, or testing activities 30 days before these operations take place. Any changes in the anticipated time of logging, testing, or other activity can be communicated to the Director as agreed upon by the concerned parties. The schedule is needed in order for the Director to determine whether these activities need to be witnessed.

H. Operating Requirements—Section 146.67

Proposed § 146.67 outlined operating requirements applicable to hazardous waste well owners/operators. Extensive comments were received on this section.

1. Annulus Pressure Requirements

Many commenters addressed § 146.67(c), which requires, under most circumstances, the maintainance of an annulus pressure that exceeds the operating pressure. This amendment was included to insure that a leak in the tubing would result in annulus fluid moving into the tubing, not in waste moving into the annulus. Some commenters supported this amendment. The majority of commenters on this section felt that Director discretion was necessary in the application of this requirement when the mechanical integrity of the well might be adversely

affected by the pressure differential. Others said that in certain situations, leak detection can be more effectively carried out when injection pressures exceed annulus pressures. One commenter requested that this requirement be waived if no USDWs are within the Area of Review. The Agency believes that the proposed language, "* * * unless such a requirement might harm the integrity of the well * * *" provides Director discretion and adequate permitting flexibility for instances when a positive hydrostatic balance across the injection tubing could lead to loss of mechanical integrity. No examples of superior leak detection in situations where injection pressures exceed annulus pressures were provided by any commenter.

Generally, EPA does not believe that lack of a USDW within the Area of Review is an adequate reason to stay this requirement for wells injecting hazardous waste. However, the existing UIC regulations at § 144.16 do allow the Director the authority to waive certain construction and other permit requirements. The Agency intends that this authority be limited in application for wells injecting hazardous waste, but does recognize that specific circumstances may warrant application of this exemption. The Agency believes that § 146.67(c) contains considerable flexibility and is therefore promulgating it as proposed.

2. Continous Recording and Alarm Requirements

The Agency proposed, in § 146.67(f), to require an operator to continuously monitor the injected fluid. In addition, EPA proposed to require the owner or operator to install either automatic shutoff systems or, in cases where the owner would verify that an operator was on site at all times, automatic alarms. These systems would sound an alarm or shut-in the system whenever pressures or flow rates exceeded a range or gradient specified in the permit.

The Agency received extensive comment on this provision, much of it supporting the requirement, but objecting to the specific parameters outlined in the proposal. Most commenters suggested that the appropriate value to monitor was the injection pressure and/or the annulus pressure. A few commenters were concerned that requiring such devices could result in the facility being shut down by "false alarms". These commenters noted that operating parameters frequently vary within an acceptable range as a result of changes in temperature, density, or other physical changes. These changes, according to the commenters, frequently fall well within permit standards.

The Agency agrees with these comments. Effective automatic shutoff or alarm systems may be designed to react to a combination of several key parameters, including those specified in the proposal. Accordingly, the final rule will afford the Director more discretion in deciding which parameters to include in the permit. With regard to the commenters concerned about "false alarms", EPA notes that the range of values which can be acceptable (i.e. those which would not trigger an alarm or shutoff system) is defined in the permit, and can be designed so that the parameters may vary within specified limits which may be both protective and sufficiently flexible to avoid unnecessary shut-ins.

A few commenters questioned the need to monitor continuously for one or the other of the temperature, flow rate, volume or injection pressure. Others suggested that the list be expanded to include other parameters such as density.

The Agency is seeking to identify information in this section which helps characterize operational characteristics of the well. Changes in any of the parameters outlined could affect the way the well operates or obscure the interpretation of reported values (for example, increases in temperature result in increased annulus pressures). The very flexibility which these commenters sought in the application of this requirement can be allowed only when the Director has access to the parameters outlined.

Requiring additional parameters to be reported is not necessary. The Agency is not seeking to define the physical and chemical properties of the waste in this requirement. That is being required in § 146.68(a)(1).

3. Fault and Fracture Propagation

A few commenters addressed § 146.67(a), which concerns the initiation and propagation of undesired faults and fractures. One wanted this section changed to allow for a "bulb" around the well bore within which horizontal fracturing of the injection zone would be permitted. The Agency believes that the integrity of an injection zone is in part contingent upon the existence of few or no vertical fractures within the injection zone. In the context of well stimulation, both vertical and horizontal fracturing are permissible when they will assist in the creation of additional safe, disposal area within the injection interval, but will not allow fracturing of the confining zone. All other pressure-induced fracturing within the injection zone is impermissible.

Another commenter felt that § 146.67(a) was unspecific in its requirements concerning allowable injection pressure, allowable fracturing during stimulation, and margins of safety. The Agency has promulgated Part 146 as a regulatory framework for both Primacy and Federally implemented states. As such, Part 146 specifies broad minimum standards which define acceptable State programs. The additional precision which the commenter requested can be found in the individual State programs in primacy States, or in Part 147 for Federally-administered programs. Part 146 was never intended to detail to the letter permit requirements. Rather it sets broad parameters within which permits are to be issued. The Agency believes the operating requirements proposed at Part 146.67(a) are appropriate for minimum standards, since there is a great deal of disparity in fracture gradients from State to State and even within a single State.

I. Testing and Monitoring Requirements—Section 146.68

The requirements for testing and monitoring are addressed in § 146.68. The Agency indicated in the August 27, 1987, proposed regulation that this section restates existing requirements more explicitly, changes some substantively, and adds new requirements. This section also adds a requirement for a waste analysis plan, establishes more precise standards for hydrogeologic compatibility determinations, specifies the requirements for the compatibility of well materials and monitoring, revises and strengthens mechanical integrity testing, and establishes more specific ambient monitoring requirements.

1. Waste Analysis Plan

The written waste analysis plan requires a description of how the waste will be analyzed and sampled and how the analysis will assure that the samples will be representative. The approach adopted by the Agency follows § 264.13(b) of the RCRA regulations and the Agency believes this to be a sensible approach. Most hazardous waste injection well operators will have surface units subject to RCRA and will have a plan already developed. One comment received for the waste analysis plan suggested that a guidance was needed for specifying the detailed chemical and physical analysis needed for this requirement. The Agency believes that a guidance is necessary,

and will issue it as soon as possible. Indeed, this guidance is under development in response to similar concerns regarding § 264.13(b). It will be issued as expeditiously as possible.

2. Hydrogeologic Compatibility

The approach to addressing hydrogeologic compatibility requires the operator to submit a plan which identifies anticipated reaction products and demonstrates to the Director's satisfaction that neither the waste nor the reaction products would adversely affect the injection or confining zone. In other words, both the injection and confining zones must continue to satisfy siting requirements in § 146.62. This amendment clarifies and adds some specificity to existing regulations in §§ 146.12 and 146.14, but does not substantially alter them.

Several concerns were indicated regarding hydrogeologic compatibility requirements. One commenter maintained that this requirement was already addressed in the § 148.20 petition process. The petition process, however, does not cover all hazardous waste injection. Moreover, for the foreseeable future, EPA will be implementing the petition process, while in many cases, States are implementing Part 146 requirements. Thus, the data may not be available for States to determine compliance.

Another commenter expressed the opinion that compatibility should only be required for the arresting layers of the injection zone and not the confining zone. The Agency disagrees and believes that in order to meet the siting requirements in § 146.62, an assessment of hydrogeologic compatibility of the confining layer must be made.

One commenter sought a change in the language addressing cases in which the waste stream in an existing well changes. The commenter believed that such a change should require the Director to take into account what the formation is like at the time of the change for the assessment of hydrogeologic compatibility. The Agency believes that this concern is addressed in the existing requirement. The owner or operator must provide information acceptable to the Director that the relevant protection characteristics of the confining and injection zones are not compromised.

3. Compatibility with Well Materials

Section 146.68(c) requires that the owner or operator of the hazardous waste well provide assurance that the materials in the well are compatible with the injected fluid. Corrosion monitoring, generally accomplished by exposing well components or coupons to the waste stream, provide the necessary data for addressing well material compatibility. Several commenters contended that continuous corrosion monitoring was usually unnecessary particularly when a non-corrosive waste stream is injected. Others suggested that such monitoring should be required in all cases, regardless of whether the waste may be corrosive nor not.

The Agency believes that in many cases, the rates of corrosion can be accurately predicted, particularly in wells with a long operating history and with a waste stream of a consistent composition. The Agency has therefore afforded the Director some latitude in requiring monitoring, as indicated in § 146.68(c)(1); the owner or operator needs only to demonstrate to the Director that the waste stream will be compatible with well materials in contact with the wastes. However, the Agency will require continuous corrosion monitoring of the well construction materials used in the well for wells injecting corrosive wastes. The Director is given the discretion to require such monitoring for other wastes, but alternative methods may be approved by the Director.

4. Mechanical Integrity Testing

Current mechanical integrity tests (MITs) require the operator to check for fluid movement behind the casing (including movement of formation fluids through cement channels adjacent to the well bore) and for leaks in the tubing, casing, or packer. These tests are to be run at least once every five years. The frequency of testing was especially controversial when the UIC regulations were initially proposed and promulgated (see 45 *FR* 42500 *et seq.*, June 24, 1980), and for this reason, in part, EPA included § 146.15 which specified that the EPA would review the adequacy of certain requirements, including MIT tests. After analyzing annual and quarterly reports and reviewing the results of the section report, the Agency has concluded that the frequency of certain tests is inadequate and that certain other tests not specified in existing regulations should be added. In several instances, problems developed and evolved within a five-year time period. While these problems were detected by routine monitoring, it suggestes that the MIT testing frequency needs to be increased.

In view of these concerns, EPA is now requiring annual pressure tests and is also requiring the operator to conduct an annual radioactive tracer survey (RTS) for wells injecting hazardous waste. This test is required in many State programs and has been approved by EPA for use in federally-implemented programs. Moreover, RTS tests are effective for locating leaks in the bottom hole cement and they can be utilized for leak detection of a well's tubular goods, and in some instances fluid flow behind casing. In addition, the Agency is now requiring the use of a tool to evaluate the casing prior to operating the well for new wells, and at least once every five years thereafter for all wells. This tool, which uses electromagnetic flux to measure the thickness of the casing, has the advantage of being predictive. It not only indicates the presence of a leak in the well casing, but also shows developing weaknesses. The language affords the Director some discretion in using this tool since it is not effective with some casing materials.

The majority of comments pertaining to this section of the proposed regulations opposed the increase in stringency of mechanical integrity testing. Many commenters were of the opinion that the mechanical integrity testing requirements were excessive even in the current regulations. They objected particularly to the casing evaluation tool, maintaining either that it should not be required in addition to existing MIT requirements or that it should only be run if a well were worked over, but in no case every five years. As previously mentioned, the Agency has determined that the predictive ability of this tool warrants its use, and the propensity for problems to develop in a well within a five year time period justifies the frequency of use, particularly with wells injecting hazardous wastes. Such wastes are often corrosive. Numerous commenters objected strongly to the prospect of pulling the tubing and packer at specific intervals in order to assess mechanical integrity and suggested that such testing be limited to periods of well workovers. They contended that pulling tubing could damage the well. The Agency disagrees. Mechanical integrity tests such as the temperature log and the noise log are currently required to be run every five years by existing regulations. These test are most sensitive when run with the tubing pulled; thus, in most cases, the tubing is being pulled every five years anyway. The casing tool, which is run with the tubing pulled, is to be run every five years as well and should not significantly contribute to the "down time" of a well as some commenters argue. Moreover, a demonstration of mechanical integrity is already required after every workover and the regulations state that the Director may

schedule the required tests to coincide with workovers whenever possible.

Several commenters also questioned the need for annual RTS testing as they also believed it was excessive and that the bottom hole cement never degrades. The Agency believes that an annual RTS test is justified in that it assures the operator that the waste stream is being emplaced in the injection zone and that the bottom hole cement is intact. In addition, use of the RTS does not require tubing to be pulled for assessing bottom hole cement and, in some cases, potential leaks in casing, tubing, or packer. Finally, in response to one comment, the Agency does not believe that visual inspection of pulled tubing is a viable alternative for a pressure test or an accurate assessment of the tubing's mechanical integrity.

5. Ambient Monitoring

The ambient monitoring requirements are specified in § 146.13 and apply to owners and operators of all Class I wells, not just those who inject hazardous waste (see Section (IV) of today's preamble). Section 146.68(e) restates these requirements as applicable to Class I hazardous waste wells in order to facilitate easy reference for the regulated community. The Agency has been investigating methods of ambient monitoring which might be useful and will continue to do so. With one exception, there appears to be no single technique which could provide meaningful data at all sites. The question of what might prove effective at a given site depends on the hydrogeologic setting and the characteristics of the operation.

Many commenters urged the deletion of the one technique that the Agency believes has the broadest application; the monitoring of the pressure decay or pressure fall-off testing of the injection zone when the well is not injecting and assessing whether the pressure decay curve tracks predictions. Commenters believed that this was not always effective, and could be inaccurate. Predicted pressure decay curves are made for siting and area of review calculations and are based on hydrogeologic data and operating parameters such as injection pressure, fluid density, and volume injected. If the geology has been accurately portrayed, then the pressure decay should generally match predictions. If an unexpected fault or fracture is transmitting fluid it will decline at a faster rate, or conversely, if a boundary condition is present then the decay curve will be slower than anticipated. The Agency agrees that no ambient monitoring system is foolproof, and agrees that false readings could occur. Nevertheless, EPA has determined this to be the most universally applicable monitoring method and has evidence showing it to be accurate in most instances. Therefore, EPA is requiring pressure decay monitoring of the injection zone annually.

There were several commenters who requested a language change in this section that would allow the Director more discretion to conduct ambient monitoring. Other commenters sought to require monitoring in the injection zone, the first aquifer above the injection zone, and the lowermost USDW. Still other commenters indicated that ambient monitoring should be strictly a site-specific requirement. The Agency agrees that ambient monitoring requirements should be site-specific and has indicated this in the proposed rule (see 52 *FR* 32463 and 32464) and today's final rule, and gives the Director discretion in determining an acceptable program.

6. Seismic Monitoring

As noted in Section (III)(C)(2) of this preamble, the Agency believes that seismicity monitoring may be necessary under certain circumstances. A 1987 USGS report indicated several key factors in determining when an injection site might be the cause of increased seismic activity: (1) a large difference between the maximum and minimum compressive stress of an area, (2) the preexistence of faults or fractures of sufficient size and orientation to facilitate induced seismic activity, (3) relatively high injection pressures, (4) clusters of wells within a relatively small area, and (5) an injection zone of low permeability. As noted in the USGS report, such conditions and the resulting earthquakes are rare, and are associated almost exclusively with water-flooding operations for the purpose of secondary recovery of oil, a Class II injection activity. Such Class II activity is often characterized by large arrays of wells injecting at high pressures into small, confined reservoirs with low permeabilities. In contrast, waste disposal wells typically inject at lower pressures into large, porous aquifers of high permeability. Only one waste well has ever been conclusively linked with seismic activity of any significant amount.

EPA believes that the potential for Class I hazardous waste injection to induce tectonic activity is minimized by a number of requirements being promulgated today. Section 146.62(b)(1) prohibits the siting of a Class I well unless the director has considered regional seismicity in his evaluation of the geologic suitability of the proposed site. Section 146.62(c)(2)(i) requires a confining zone that is laterally continuous and free of transecting faults or fractures, a requirement which improves the confining zone's ability to prevent increased seismic activity.

The Agency can foresee, however, limited circumstances where local seismic monitoring may be necessary. Seismic stations are neither expensive nor burdensome in the time required for their installation and operation. Today's final rule at § 146.68(f) will provide the Director the authority to require seismic monitoring on a case-by-case basis. The results of any monitoring required under this section will be reported under § 146.69(a)(7).

J. Reporting Requirements—Section 146.69

Section 146.69 of the proposal detailed the minimum reporting requirements for owners and operators of Class I hazardous waste injection wells. A variety of comments were submitted concerning this section.

1. Injectivity Index

The Agency received several comments on § 146.69(a)(2), which required the owner or operator to report changes in the ratio between injection pressure and flow rate. In the proposal, the Agency tied this reporting requirement to the gradients established in § 146.67(f) which are used to trigger automatic alarms or shutoff devices.

As several commenters correctly pointed out, the ratio between injection pressure and flow rate—commonly termed the injectivity index—is best used to evaluate the long term performance of the injection formation. Thus, tying the requirement to the provisions in § 146.67(f) makes little sense, and the Agency is changing this requirement in the final rule to reflect the more appropriate application of this requirement.

Some commenters suggested that there was no legitimate need to require operators to report information on injectivity indexes. They contended that the primary purpose was to tell the operator when it may be necessary to stimulate the formation or conduct other routine maintenance. If the only result of such observations were to note an orderly increase in pressure while flow remained relatively stable, this commenter would be correct. The obvious conclusion to be made from this observation would be that the formation or well screen was becoming clogged—an operational inconvenience, but in most instances not an environmental

concern. However, other outcomes may be observed. For example, a decrease in pressure with flow remaining constant or increasing, could indicate that the formation is fracturing or that a point of discharge has been reached. Similarly, an increase in flow while pressure remained constant could provide evidence that there were problems with the formation or the geologic description. Accordingly, the Agency rejects the contention that reporting the injectivity index has no legitimate regulatory purpose, and retains the requirement with the change outlined above.

2. Shutdown Requirements

Section 146.69(a)(3), the new alarm, shutdown, and resulting response requirements, received many comments. Of particular concern to some was discrepancy between this section and § 146.67. In the preamble of the proposal, EPA addressed false alarms or shutdowns, stating that, "The Agency is not interested in receiving a report any time such an event occurs; nor would it want the operator to shut in the well under these circumstances." This position, while reflected in § 146.67, was not clearly stated in the reporting requirements at § 146.69(a)(3). The Agency believes that there is no immediate need to report false alarms or shutdowns. Such requirements place unnecessary burden on both operator and regulator. Today's final rule at § 146.69(a)(3) requires immediate Director notification only if a loss of mechanical integrity is expected. Other routine occurrences would be reported with quarterly reports.

3. Annular Fluid Loss or Gain

Two commenters believed that § 146.69(a)(5) should require the reporting of not only annular fluid lost, if any, but also annular fluid gained, if any. They noted that this would serve a dual purpose: 1) the indication of leaks in the well tubing; and 2) the indication of situations where, contrary to the new § 146.67(c) requirements, injection pressure exceeds annular pressure. The Agency believes that this comment has validity, and today's promulgation of § 146.69(a)(5) reflects this new requirement.

K. Information to be Evaluated by the Director—Section 146.70

Section 146.70 sets forth the information which must be evaluated by the Director in authorizing Class I hazardous waste wells. This section essentially restates the information required in § 146.14 of the existing regulations. As such, the Agency believes it is under no obligation to address comments which are targeted at the already promulgated standards of § 146.14 and simply recodified at § 146.70 for the benefit of the injection community. Substantive comments relevant to proposed additions or changes, however, are addressed below.

One commenter requested that the location of any penetrations of the additional confining zone required by § 146.62(d)(1) be submitted to the Director as a § 146.70 requirement. Another commenter believed that the time at which closure/post-closure plans are to be submitted should be included in § 146.70. The requirement for information in § 146.70 on wells which penetrate the confining or injection zone was duplicative, according to one commenter. One group believed that this section omitted the regional seismicity information required in § 146.62. Prior to the issuance of a permit, one commenter believed that the chemical and physical characteristics of the fluid to be injected should be evaluated by the Director. Finally, one commenter believed that the requirement for a program to reduce the volume or quantity and toxicity of the waste produced at a facility should be approved by the Director.

1. Confining Zone Penetrations

One commenter requested that the added second confining stratum provided by § 146.62(d)(1) be deleted, stating that "it will create far more problems than it is intended to solve . . .". This same commenter went on to suggest that EPA request the location of any penetrations of this stratum as well as an evaluation of the potential for further migration through this stratum. The Agency notes that the location of these wells will be required under § 146.70(a)(2). However, EPA believes that this stratum, while adding an additional measure of protection to an injection site, does not need to be part of the corrective action plan.

One commenter requested the inclusion, in § 146.70, of deadlines for the submission of post-closure plans. These plans are required as part of the permitting process. As the commenter noted, these plans must be submitted with the initial permit application. The Agency sees no need to further regulate this action, as similar plans for plugging and abandonment have been handled in a timely manner to this point.

Another commenter wanted to delete the phrase "injection zone" from §§ 146.70 (a)(3), (a)(4), and (a)(15) as well as other areas. He indicated that "The proposed regulations request information on wells which 'penetrate the injection zone or the confining zone' * * * All wells which penetrate the confining zone is sufficient. If a well penetrates the injection zone it will have penetrated the confining zone." In requiring the owner or operator to consider penetrations of the confining zone, the EPA was seeking to address partial penetrations of that zone, not to reopen the existing requirements relative to injection zones.

Therefore, today's promulgation remains unchanged from the proposal, in this regard.

2. Regional Seismicity

One group noted that the regional seismicity siting requirement of § 146.62(b)(1) was not included in § 146.70 as information to be evaluated by the Director. Pursuant to § 146.70(a)(2), the applicant must show the location of known or suspected faults. Section 146.70(a)(6) requires an analysis of the regional geologic structure, and § 146.70(a)(9) requires a formation testing program. Together, these information requirements provide the data which allows the owner or operator and the Director to assure that the requirements of §146.62(b)(1) have been met. The issue of seismicity monitoring is addressed in section (III)(I)(6) of the preamble.

3. Waste Stream Analysis

One commenter believed that the Director should evaluate chemical and physical characteristics of the fluid to be injected before issuing a permit. The Agency believes that the waste stream analysis required by § 146.68(a), combined with the compatibility requirements of §§ 146.68 (b) and (c), and § 146.70(b)(6) adequately address this issue. The same commenter requested that specific gravity be included as one of the waste stream analysis requirements. Specific gravity analysis is an implicit requirement of §146.68(a) and does not need to be codified at § 146.70.

One commenter felt that the Director should approve the § 146.70(d)(1) certification that the generator of hazardous wastes (at a site which disposes of its own hazardous waste) is implementing a waste minimization program that is protective of human health and the environment. The Agency notes that the regulatory language tracks the statutory language in § 3005(h), which merely requires a certification. Accordingly, the Agency believes that the proposed language is most consistent with the legislative mandate and today promulgates the language as proposed.

L. Closure—Section 146.71

The Agency reorganized and consolidated existing requirements for closure in the proposed rule. To the extent that these represent a restatement of existing requirements, the Agency is neither seeking comment nor making any changes. However, EPA has addressed concerns regarding any new requirements proposed.

Three new requirements for closure include: (1) Requiring the owner or operator to observe and record pressure decay for a time specified by the Director, (2) requiring the demonstration of mechanical integrity prior to plugging, and (3) clarifying that both the owner or operator as well as a third party, if different, must certify that the facility was closed in accordance with the closure plan.

1. Pressure Decay Data

Most of the commenters objected to the proposed provision requiring the owner or operator to observe and record pressure decay over a time period specified by the Director. While there was some support for this part of the closure plan, several commenters indicated that it was either not essential or should not be an automatic requirement.

The Agency believes that pressure decay data helps define the appropriate period of regulatory concern. Specifically, when injection induced pressures in the formation decay, there is usually no force which will lift the fluid to overlaying strata, and thus there is no environmental threat. In overpressurized formations, this lifting force may remain but observation of plugged wells over a thirty year time period provides sufficient assurance that the wells are plugged in a satisfactory manner, and will continue to provide containment for the long term. Accordingly, this requirement will remain as proposed.

2. Cementing and MIT Requirements

Several commenters were of the opinion that tests to ensure mechanical integrity of the long string casing and cement left in the ground before plugging was not necessary and should not be an automatic requirement.

The Agency disagrees and further notes that the EPA presently requires this demonstration of mechanical integrity in permits in all federally-administered programs. Obviously, a well with casing leaks should not be plugged as it can eventually become a source of contamination during the post-closure period.

One commenter noted that just the placement of cement plugs in casing prior to closure will not prevent fluid movement into USDWs. EPA agrees, and it is for precisely this reason that EPA requires MIT tests prior to plugging. Moveover, the rule specifies that the plugging must be done in a manner that will not allow movement of fluids into or between USDWs, and requires certain actions such as perforating the casing where leaks may develop, or placing cement behind casing prior to setting a plug. The actions are designed to assure that the performance standards are met.

3. Authority to Temporarily Cease Injection

One commenter expressed the concern that the Agency's rewarding of the current § 144.28 language created some uncertainty as to when an operator must seek authorization to temporarily cease injection.

It is the intent of this rule that the owner or operator notify the Director immediately upon deciding to temporarily cease injection. The Agency did not intend, however, to require an owner or operator to report well shut-ins associated with routine maintenance or testing activities. Rather, the notification should be initiated by the decision to take the well out of service. In the proposed rule, the Agency intended that the owner or operator seek the permission of the Director in writing, outlining the technical steps being taken to assure continued non-endangerment of USDWs.

4. "Closure"

Another commenter questioned the use of "plugging and abandonment" in the proposed regulations whereas RCRA uses "closure" in referring to this procedure.

"Plugging and abandonment" has been a term used in injection well closure for years. It refers specifically to the closure of a well. The term "closure", which is used in RCRA, pertains to the technical procedures appropriate to shutting-in a surface impoundment, landfill, or other surface land disposal, treatment, or generator facility. In using "plugging and abandonment" versus "closure" there is no difference in the protectiveness of the standard being applied, there is merely a difference in the types of units that the term refers to.

One commenter has suggested that the time requirement for closure report submission is unreasonable as the submission of the report may be required in as little as 15 days if a quarterly report is also due.

The Agency promulgated this requirement on May 11, 1984. It was proposed on September 2, 1983 (see 49 FR 20185 and 48 FR 40098 *et seq.* respectively). This rule was litigated and a settlement was reached. The Agency was not intending to seek comment, nor was it reproposing the requirement; it was merely recodifying the requirement. Accordingly, EPA sees no reason to amend a requirement which has been in effect for nearly 5 years, and which apparently has caused no great hardship to the regulated community.

Finally, some commenters maintained that existing closure requirements were adequate and that these proposed requirements were excessive. The Agency would like to note that, in general, today's rule merely restates what has been existing practice, either as part of permitting (as in the case of required mechanical integrity tests) or as part of earlier rulemaking. In the few instances where the Agency has specified additional or more specific requirements, it has done so primarily to make the closure requirements for wells injecting hazardous waste comparable to closure requirements for other facilities managing hazardous waste.

Several commenters requested clarification on how closure and post closure requirements would be applied. This is outlined in the section which follows.

M. Post-Closure Care and Financial Responsibility for Post-Closure Care—Sections 146.72 and 146.73

The Agency is now applying post-closure care requirements and associated financial responsibility requirements to hazardous waste injection wells. The Agency believes that even though a properly chosen site should contain the waste indefinitely under natural conditions, future injection activities, oil and gas drilling activities, and other man-induced forces that may affect containment must be taken into account. The Agency believes that the special problems associated with hazardous waste warrant these new requirements.

1. Post-closure Care

Comments received by the Agency pertaining to post-closure care were generally supportive of the new requirements. However, several concerns were voiced by commenters on various issues.

The regulations, as proposed, stipulated the appropriate time-frames for groundwater monitoring, retention of well records, and notification to State and local agencies having authority over

drilling activities. The rule would also require the owner of the surface or subsurface property on or in which a hazardous waste well is located to record certain information on the deed or other property instrument that would, in perpetuity, provide notice to any subsequent purchaser of the property.

A few commenters were unclear as to when the post-closure period ends. As indicated in the proposal, the duration of the post-closure care period is defined by the length of time the increased pressure from the injection well would create the potential to "lift" fluids from the injection zone. As the injection pressure decreases to a point where the induced lift from the well is dissipated, post-closure requirements would become unnecessary.

In response to concerns about the clarity of the rule, the Agency is changing the manner in which it applies both closure and post-closure care requirements. As promulgated today, the owner or operator would have to submit a plan for the Director's approval which outlined the closure and post-closure care procedures. The requirements of this plan would survive permit termination. Any changes which might be required in the plan could be made using the procedures of § 124.5.

One commenter suggested that the notation on the deed required by § 146.72(c) pertain to any property located over the projected position of the waste plume. The Agency does not believe it is necessary, or legally possible to impose such a requirement. It is generally unnecessary because waste in deep formations moves at exceedingly slow rates; thus in many cases it is unlikely that the waste plume will move appreciably over very long time frames. Moreover, area of review and corrective action requirements will have addressed any concern associated with abandoned wells. As noted, these requirements are based on the pressure front from the well, which exceeds the plume by a considerable distance. Thus, there is built-in protection for plume travel in these requirements.

More importantly, the Agency derives its authority by imposing permit requirements on the regulated entity. No such vehicle exists for surrounding landowners. Therefore, the Agency sees neither the technical necessity nor the legal authority for such a request. Accordingly, EPA will retain the requirement as proposed.

Several commenters noted that required groundwater monitoring should only be conducted until pressure in the injection zone decays to the point that there is no longer any risk of vertical migration into USDWs. The Agency agrees and although preamble language in the proposed rule indicated that such monitoring must be conducted until pressure in the injection zone reaches background levels, language in § 146.72 stipulates that groundwater monitoring must take place until pressure in the injection zone decays to the point that the well's cone of influence no longer intersects the base of the lowermost USDW. The Director may extend the period of post-closure monitoring if he determines that the well may still endanger a USDW.

One commenter believed that groundwater monitoring should be limited only to the lowermost USDW. As noted in the discussion of § 146.68 in this preamble, the Agency has determined that monitoring requirements must be applied in a flexible manner to address site specific concerns. Therefore, EPA continues to believe that the specific monitoring required by the permit is still essential and will continue to be applied if the pressure from the injection poses a threat to a USDW.

Another commenter indicated that the permittee, not the Director, should estimate the proposed cost of the post-closure plan. The Agency clearly stated in the proposal that the permittee is required to provide this cost estimate, and further believes that he is in the best position to accurately do so. The Director, in reviewing the estimate, will have the opportunity to reject it if he deems it unrealistic.

One commenter explained that the original formation pressure may not have been obtained for many existing wells and that it is not possible to meet the § 146.72(a)(3) requirement in these cases. The Agency agrees, but notes that regulations contain enough flexibility to allow existing wells which have not conducted tests verifying background pressures prior to injection to use reasonable estimates based on available data acceptable to the Director.

2. Financial Responsibility

The Agency proposed that the owner or operator should demonstrate and maintain financial responsibility for post-closure care. Only a few comments were received pertaining to this requirement.

Two commenters believed that financial responsibility should be limited only to the time period when induced pressures in the injection zone remain sufficiently elevated to pose a risk of vertical migration into USDWs, and not until injection zone pressures decay to background levels. Another commenter also felt that the financial responsibility for post-closure groundwater monitoring should be required only if the permit requires such monitoring.

The Agency agrees with these commenters and articulated this position in the proposed rule. Therefore, EPA is not revising this requirement and will retain it as proposed.

One commenter believed that permittees should be responsible for third party liability costs and that they should demonstrate up-front financial responsibility for cleanup in the event that the waste does contaminate a USDW. The Agency does not believe that in the context of injection wells, such requirements are warranted or justified. Generally, once the formation has stabilized, there is little or no possibility that waste will move vertically.

Finally, one commenter recommended that the Agency use the RCRA post-closure financial responsibility instruments.

The rule proposed to use the requirements of subpart F of Part 144. A careful analysis of this subpart will show that these requirements mirror exactly the requirements outlined in sections 265 and 264 of the RCRA regulations.

IV. Summary of Today's Rulemaking: Response to Comments; Section 146.13, Ambient Monitoring for all Class I Wells

As proposed, § 146.13 addressed the requirements for owners or operators of *all* Class I wells to develop an ambient monitoring program. This part of the rule would also satisfy the mandate of section 1426 of the Safe Drinking Water Act. These requirements differ from other requirements made today in that they are not restricted solely to Class I hazardous waste wells, but rather they are applicable to all Class I wells.

At a minimum the proposed rules required a monitoring of the pressure buildup in the injection zone. This would require an annual shut down of the well for a period of time sufficient to conduct a valid observation of the pressure fall-off curve.

At the Director's discretion, it was proposed that one or more of the following site-specific monitoring techniques may also be required in order to prevent the contamination of USDWs:

1. Continuous monitoring for pressure changes in the first aquifer overlying the confining zone;

2. The use of indirect, geophysical techniques to determine pertinent characteristics of the formation and injected fluids;

3. Periodic monitoring of the ground water quality in the lowermost USDW; or

4. Any other technique which the Director deems necessary to protect USDWs.

Further details concerning ambient monitoring and the response to several comments can be found in the preamble language in Testing and Monitoring, § 146.68(e) of today's rule.

As many commenters indicated, the question of what might prove effective at a given site depends on the hydrogeologic setting and the characteristics of the operation. Many commenters urged the deletion of the one technique that the Agency believes has the best application; the monitoring of a pressure decay or pressure fall-off testing of the injection zone when the well is not injecting, and assessing whether the decay curve tracks predictions. Commenters believed that this was not always effective, was too costly, and could be inaccurate. Although some of these concerns may be valid, EPA has determined that this is the most universally applicable monitoring technique and has evidence showing it to be accurate in most cases. Therefore, the Agency will require pressure decay monitoring of the injection zone annually.

Some commenters were of the opinion that ambient monitoring was too costly and should be optional. The Agency does not believe that this type of monitoring is particularly expensive when compared to the information received. Still other commenters believed that certain site-specific monitoring techniques that may also be required by the Director were either inappropriate or flawed in preventing the contamination of USDWs. In response, the Agency agrees that ambient monitoring requirements should be site-specific and has indicated this in the proposal and today's rule, and has therefore given the Director discretion in determining an acceptable ambient monitoring program.

V. Summary of Today's Rulemaking: Response to Comments; Amendments to Parts 124 and 144

A. Part 124

The Agency proposed to amend Part 124 to require that State and local agencies which regulate oil and gas activities, and state agencies that regulate mineral exploration be notified, by operators, of permit activities for all Class I wells. This practice could help agencies coordinate their programs and apply specific requirements when appropriate. One commenter supported this idea, but felt it should work both ways, i.e., that State and local agencies regulating oil, gas, or mineral exploration and recovery should give notice of their permit activities to the agency regulating Class I facilities. The EPA believes that such coordination would be beneficial to all involved parties, but also realizes that its authority to require such notification from State regulatory bodies is questionable. The EPA intends to take all necessary measures to insure that federal, State, and local regulatory bodies are notified of all federally implemented injection activities.

Two commenters believed that the new requirement to notify agencies of permit activities was burdensome. The Agency believes that such a requirement is not unreasonable in the context of other § 124.10 notification requirements. On the contrary, EPA believes that such notification is appropriate, given the special concerns associated with hazardous waste injection.

B. Part 144

The proposal contained two amendments to Part 144. Section 144.31(h) was proposed to assure that plugging and abandonment, closure, and post-closure requirements are met. As outlined in Section (III)(M)(1) of this preamble, the Agency is changing the approach. Under the new approach, the plan will be submitted as part of a permit application or modification, but will survive the permit as a directly enforceable requirement until the end of the post closure period.

The Agency is also amending § 144.52(a) ("Establishing Permit Requirements") to ensure that all Subpart G requirements can be administered through a permit, consistent with the framework established for the UIC program.

Amendments to §§ 144.39 (a) and (b) would broaden the reasons for which permits may be modified or revoked and reissued. Specifically, this section would require permit modification either when regulations change, or when the waste is changed or reclassified. The intent of this change is to give the Director the discretion to revise or reissue a permit when the waste becomes or is determined to be hazardous as defined in Part 261.

Many commenters objected to the removal of the "shield" provision. This provision currently prevents the modification, revocation, or reissuance of a permit to require compliance with new regulations unless the permittee requests or agrees to such action. They argue that the Part 146 requirements have, to this point, proved protective of human health and the environment. The HSWA Amendments impose new, higher levels of concern on hazardous waste facilities. Recently proposed rules to amend the regulations governing the disposal of hazardous waste in surface facilities would broaden the Director's authority to revise permits when conditions warrant such revisions, and the Agency believes that rules applicable to injection of hazardous wastes should mirror this new approach.

A number of commenters believed that Part 144 should contain a section that would grant interim permit status to wells with approved petitions. It is their opinion that such approved petitions are similar in kind to a valid permit, and that administrative procedures associated with the repermitting process may delay the continued operation or startup of their facilities.

In response, EPA would like to note that an approved permit and an approved petition are similar in certain aspects, but they do not address identical concerns. The Part 148 petition process does not contain provisions pertaining to the movement of formation fluids. The SDWA, however, requires the Agency to regulate endangerment of USDWs, regardless of whether that endangerment were to occur from injected wastes or formation fluids. The movement of formation fluids is regulated through an approved permit.

Review and approval of both a permit and a petition are required to insure protection of human health and the environment, and non-endangerment of USDWs. It should be noted that the Agency will attempt to run concurrent petition and permit review processes whenever possible.

One commenter addressed § 144.36 and the duration of permits. No change was proposed to this section, and consequently we are not addressing it.

VI. Regulatory Requirements

A. Regulatory Impact Analysis

Executive Order 12291 requires EPA to assess the effect of contemplated Agency actions during the development of regulations. Such an assessment consists of a quantification of the potential benefits and costs of the rule, as well as a description of any benefical or adverse effects that cannot be quantified in monetary terms. In addition, Executive Order 12291 requires that regulatory agencies prepare an analysis of the regulatory impact of major rules. Major rules are defined as those likely to result in:

1. An annual cost to the economy of $100 million or more; or

2. A major increase in costs or prices for consumers or individual industries; or

3. Significant adverse effects on competition, employment, investment, innovation or international trade.

At the request of the Office of Management and Budget, the Agency has reexamined this final rule in light of the changes made since the proposal, and their effect on its status as a minor rule. This economic analysis indicates that the changes made will have no appreciable effect on the compliance costs estimated for the rule proposed on August 27, 1987. Total annualized compliance costs of the regulation are estimated to total $63 million. Total capital costs are estimated to total $15 million and one-time petition costs are estimated to be $3 million. These costs indicate that the rule does not constitute a major rule under Executive Order 12291 and EPA has not prepared a formal regulatory impact analysis of today's promulgation. The Agency has, however, prepared an assessment of the cost and potential economic effects of the rule.

B. Regulatory Flexibility Analysis

Pursuant to the Regulatory Flexibility Analysis Act, 5 U.S.C. 601 *et seq.*, whenever an agency is required to publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (*i.e.*, small businesses, small organizations, and small governmental jurisdictions). This analysis is unnecessary, however, if the agency's administrator certifies that the rule will not have significant economic effect on a substantial number of small entities.

Owners and operators of hazardous waste injection wells are generally major chemical, petrochemical and other manufacturing companies. The Agency is not aware of any small entities that would be directly affected by this rule. Part 148.1(c)(3) of this rule exempts any small quantity generator, as defined in § 261.5, from the underground injection prohibitions outlined in this rule. The Administrator certifies that this rule will not have significant economic effects on a substantial number of small businesses. As a result of this finding EPA has not prepared a formal Regulatory Flexibility Analysis.

C. Paperwork Reduction Act

The information collection requirements in this rule have been approved by the Office of Management and Budget (OMB) under the *Paperwork Reduction Act*, 44 U.S.C. 3501 *et seq.* The Agency has amended the Information Collection Request document to address concerns raised by OMB. A copy of this document (ICR No. 0370) may be obtained from Eric Strassler, Information Policy Branch; EPA; 401 M St., SW. (PM-223); Washington, DC 20460 or by calling (202) 382-2738.

D. Administrative Procedures Act

As a petition may grant a variance from a prohibition, EPA may make Part 148 immediately effective pursuant to the Administrative Procedures Act (see 5 U.S.C. 553(d)(1)). The Agency is choosing to do so as the statutory deadline establishing prohibitions is effective August 8, 1988. Except to the extent incorporated in Part 148, the amendments to Parts 124, 144 and 146 become effective 30 days after publication in the **Federal Register.**

VII. References

A. Reference List for Part 148

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B. Reference List for Part 146

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3. Class I Hazardous Waste Injection Wells Evaluation of Non-Compliance Incidents, 1986, Engineering Enterprises, Inc. report prepared for U.S. EPA, Office of Drinking Water, UIC Contract No. 68-01-7011, 295 pages.
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List of Subjects

40 CFR Part 124

Administrative practice and procedure, Hazardous materials, Waste treatment and disposal, Water pollution control, Water supply.

40 CFR Part 144

Administrative practice and procedure, Hazardous materials, Reporting and recordkeeping requirements, Confidential business information, Waste treatment and disposal, Water supply.

40 CFR Part 146

Administrative practice and procedure, Hazardous materials, Reporting and recordkeeping requirements, Waste treatment and disposal, Water pollution control, Water supply.

40 CFR Part 148

Administrative practice and procedures, Confidential business information, Hazardous materials, Intergovernmental relations, Waste treatment and disposal, Water pollution control, Water supply.

Date: July 15, 1988.

Lee M. Thomas,

Administrator.

Therefore Chapter I of Title 40 is amended as follows:

PART 124—PROCEDURES FOR DECISION MAKING

1. The authority citation for Part 124 continues to read as follows:

Authority: Resource Conservation and Recovery Act, 42 U.S.C. 6901 *et seq.*; Safe Drinking Water Act, 42 U.S.C. 300f *et seq.*; Clean Water Act, 33 U.S.C. 1251 *et seq.*; and Clean Air Act, 42 U.S.C. 1857 *et seq.*

2. Section 124.10 is amended by redesignating paragraphs (c)(1)(viii) and (IX) as paragraphs (c)(1)(ix) and (x) and adding a new paragraph (c)(1)(viii) to read as follows:

§ 124.10 Public notice of permit actions and public comment period.

* * * * *

(c) * * *

(1) * * *

(viii) For Class I injection well UIC permits only, state and local oil and gas regulatory agencies and state agencies regulating mineral exploration and recovery;

* * * * *

PART 144—UNDERGROUND INJECTION CONTROL PROGRAM

1. The authority citation for Part 144 is revised to read as follows:

Authority: Pub. L. 93-523, as amended by Pub. L. 95-190, Pub. L. 96-63, and Pub. L. 96-502, 42 U.S.C. 300f *et seq.* and 6901 *et seq.*

2. Section 144.1 is amended by adding new paragraph (f)(1)(vi) to read as follows:

§ 144.1 Purpose and scope of Part 144.

* * * * *

(f) * * *

(1) * * *

(vi) Subpart F sets forth the financial responsibility requirements for owners and operators of all existing and new Class I hazardous waste injection wells.

* * * * *

3. Section 144.39 is amended by revising the introductory texts of paragraphs (a) and (a)(3), and by adding a new paragraph (b)(3) to read as follows:

§ 144.39 Modification or revocation and reissuance of permits.

* * * * *

(a) *Causes for modification.* The following are causes for modification. For Class I hazardous waste injection wells, Class II, or Class III wells the following may be causes for revocation and reissuance as well as modification; and for all other wells the following may be cause for revocation or reissuance as well as modification when the permittee requests or agrees.

* * * * *

(3) *New regulations.* The standards or regulations on which the permit was based have been changed by promulgation of new or amended standards or regulations or by judicial decision after the permit was issued. Permits other than for Class I hazardous waste injection wells, Class II, or Class III wells may be modified during their terms for this cause only as follows:

* * * * *

(b) * * *

(3) A determination that the waste being injected is a hazardous waste as defined in § 261.3 either because the definition has been revised, or because a previous determination has been changed.

* * * * *

4. Section 144.51 is amended by revising paragraph (j)(2)(ii) to read as follows:

§ 144.51 Conditions applicable to all permits.

* * * * *

(j) * * *

(2) * * *

(ii) The nature and composition of all injected fluids until three years after the completion of any plugging and abandonment procedures specified under § 144.52(a)(6), or under Part 146 Subpart G as appropriate. The Director may require the owner or operator to deliver the records to the Director at the conclusion of the retention period. For EPA administered programs, the owner or operator shall continue to retain the records after the three year retention period unless he delivers the records to the Regional Administrator or obtains written approval from the Regional Administrator to discard the records.

* * * * *

5. Section 144.52 is amended by revising paragraph (a) introductory text, to read as follows:

§ 144.52 Establishing permit conditions.

(a) In addition to conditions required in § 144.51, the Director shall establish conditions, as required on a case-by-case basis under § 144.36 (duration of permits), § 144.53(a) (schedules of compliance), §144.54 (monitoring), and for EPA permits only § 144.53(b) (alternate schedules of compliance), and § 144.4 (considerations under Federal law). Permits for owners or operators of hazardous waste injection wells shall

include conditions meeting the requirements of § 144.14 (requirements for wells injecting hazardous waste), §§ 144.52(a)(7) and (a)(9), and subpart G of Part 146. Permits for other wells shall contain the following requirements, when applicable.

* * * * *

PART 146—UNDERGROUND INJECTION CONTROL PROGRAM: CRITERIA AND STANDARDS

1. The authority citation for Part 146 is revised to read as follows:

Authority: Pub. L. 93–523, as amended by Pub. L. 95–190, Pub. L. 96–63, and Pub. L. 96–502, 42 U.S.C. 300 f *et seq.*, as amended—Subpart G also issued under 52 U.S.C. 6901 *et seq.*, as amended.

2. Section 146.11 is revised to read as follows:

§ 146.11 Criteria and standards applicable to Class I nonhazardous wells.

This subpart establishes criteria and standards for underground injection control programs to regulate Class I nonhazardous wells.

3. Section 146.13 is amended by adding a new paragraph (d) to read as follows:

§ 146.13 Operating monitoring and reporting requirements.

* * * * *

(d) *Ambient monitoring.* (1) Based on a site-specific assessment of the potential for fluid movement from the well or injection zone and on the potential value of monitoring wells to detect such movement, the Director shall require the owner or operator to develop a monitoring program. At a minimum, the Director shall require monitoring of the pressure buildup in the injection zone annually, including at a minimum, a shut down of the well for a time sufficient to conduct a valid observation of the pressure fall-off curve.

(2) When prescribing a monitoring system the Director may also require:

(i) Continuous monitoring for pressure changes in the first aquifer overlying the confining zone. When such a well is installed, the owner or operator shall, on a quarterly basis, sample the aquifer and analyze for constituents specified by the Director;

(ii) The use of indirect, geophysical techniques to determine the position of the waste front, the water quality in a formation designated by the Director, or to provide other site specific data;

(iii) Periodic monitoring of the ground water quality in the first aquifer overlying the injection zone;

(iv) Periodic monitoring of the ground water quality in the lowermost USDW; and

(v) Any additional monitoring necessary to determine whether fluids are moving into or between USDWs.

3. A new Subpart G is added to read as follows:

Subpart G—Criteria and Standards Applicable to Class I Hazardous Waste Injection Wells

Sec.

Subpart G—Criteria and Standards Applicable to Class I Hazardous Waste Injection Wells

§ 146.61 Applicability.

(a) This subpart establishes criteria and standards for underground injection control programs to regulate Class I hazardous waste injection wells. Unless otherwise noted this Subpart supplements the requirements of Subpart A and applies instead of Subpart B to Class I hazardous waste injection wells.

(b) *Definitions.*

Cone of influence means that area around the well within which increased injection zone pressures caused by injection into the hazardous waste injection well would be sufficient to drive fluids into an underground source of drinking water (USDW).

Existing well means a Class I well which was authorized prior to August 25, 1988 by an approved State program, or an EPA-administered program or a well which has become a Class I well as a result of a change in the definition of the injected waste which would render the waste hazardous under § 261.3 of this Part.

Injection interval means that part of the injection zone in which the well is screened, or in which the waste is otherwise directly emplaced.

New well means any Class I hazardous waste injection well which is not an existing well.

Transmissive fault or fracture is a fault or fracture that has sufficient permeability and vertical extent to allow fluids to move between formations.

§ 146.62 Minimum criteria for siting.

(a) All Class I hazardous waste injection wells shall be sited such that they inject into a formation that is beneath the lowermost formation containing within one quarter mile of the well bore an underground source of drinking water.

(b) The siting of Class I hazardous waste injection wells shall be limited to areas that are geologically suitable. The Director shall determine geologic suitability based upon:

(1) An analysis of the structural and stratigraphic geology, the hydrogeology, and the seismicity of the region;

(2) An analysis of the local geology and hydrogeology of the well site, including, at a minimum, detailed information regarding stratigraphy, structure and rock properties, aquifer hydrodynamics and mineral resources; and

(3) A determination that the geology of the area can be described confidently and that limits of waste fate and transport can be accurately predicted through the use of models.

(c) Class I hazardous waste injection wells shall be sited such that:

(1) The injection zone has sufficient permeability, porosity, thickness and areal extent to prevent migration of fluids into USDWs.

(2) The confining zone:

(i) Is laterally continuous and free of transecting, transmissive faults or fractures over an area sufficient to prevent the movement of fluids into a USDW; and

(ii) Contains at least one formation of sufficient thickness and with lithologic and stress characteristics capable of preventing vertical propagation of fractures.

(d) The owner or operator shall demonstrate to the satisfaction of the Director that:

(1) The confining zone is separated from the base of the lowermost USDW by at least one sequence of permeable and less permeable strata that will provide an added layer of protection for the USDW in the event of fluid movement in an unlocated borehole or transmissive fault; or

(2) Within the area of review, the piezometric surface of the fluid in the injection zone is less than the piezometric surface of the lowermost USDW, considering density effects, injection pressures and any significant pumping in the overlying USDW; or

(3) There is no USDW present.

(4) The Director may approve a site which does not meet the requirements in paragraphs (d) (1), (2), or (3) of this section if the owner or operator can demonstrate to the Director that because of the geology, nature of the waste, or other considerations, abandoned boreholes or other conduits would not cause endangerment of USDWs.

§ 146.63 Area of review.

For the purposes of Class I hazardous waste wells, this section shall apply to the exclusion of § 146.6. The area of review for Class I hazardous waste injection wells shall be a 2-mile radius around the well bore. The Director may specify a larger area of review based on the calculated cone of influence of the well.

§ 146.64 Corrective action for wells in the area of review.

For the purposes of Class I hazardous waste wells, this section shall apply to the exclusion of § 144.55 and § 146.07.

(a) The owner or operator of a Class I hazardous waste well shall as part of the permit application submit a plan to the Director outlining the protocol used to:

(1) Identify all wells penetrating the confining zone or injection zone within the area of review; and

(2) Determine whether wells are adequately completed or plugged.

(b) The owner or operator of a Class I hazardous waste well shall identify the location of all wells within the area of review that penetrate the injection zone or the confining zone and shall submit as required in § 146.70(a):

(1) A tabulation of all wells within the area of review that penetrate the injection zone or the confining zone; and

(2) A description of each well or type of well and any records of its plugging or completion.

(c) For wells that the Director determines are improperly plugged, completed, or abandoned, or for which plugging or completion information is unavailable, the applicant shall also submit a plan consisting of such steps or modification as are necessary to prevent movement of fluids into or between USDWs. Where the plan is adequate, the Director shall incorporate it into the permit as a condition. Where the Director's review of an application indicates that the permittee's plan is inadequate (based at a minimum on the factors in paragraph (e) of this section), the Director shall:

(1) Require the applicant to revise the plan;

(2) Prescribe a plan for corrective action as a condition of the permit; or

(3) Deny the application.

(d) Requirements:

(1) Existing injection wells. Any permit issued for an existing Class I hazardous waste injection well requiring corrective action other than pressure limitations shall include a compliance schedule requiring any corrective action accepted or prescribed under paragraph (c) of this section. Any such compliance schedule shall provide for compliance no later than 2 years following issuance of the permit and shall require observance of appropriate pressure limitations under paragraph (d)(3) until all other corrective action measures have been implemented.

(2) New injection wells. No owner or operator of a new Class I hazardous waste injection well may begin injection until all corrective actions required under this section have been taken.

(3) The Director may require pressure limitations in lieu of plugging. If pressure limitations are used in lieu of plugging, the Director shall require as a permit condition that injection pressure be so limited that pressure in the injection zone at the site of any improperly completed or abandoned well within the area of review would not be sufficient to drive fluids into or between USDWs. This pressure limitation shall satisfy the corrective action requirement. Alternatively, such injection pressure limitation may be made part of a compliance schedule and may be required to be maintained until all other required corrective actions have been implemented.

(e) In determining the adequacy of corrective action proposed by the applicant under paragraph (c) of this section and in determining the additional steps needed to prevent fluid movement into and between USDWs, the following criteria and factors shall be considered by the Director:

(1) Nature and volume of injected fluid;

(2) Nature of native fluids or byproducts of injection;

(3) Geology;

(4) Hydrology;

(5) History of the injection operation;

(6) Completion and plugging records;

(7) Closure procedures in effect at the time the well was closed;

(8) Hydraulic connections with USDWs;

(9) Reliability of the procedures used to identify abandoned wells; and

(10) Any other factors which might affect the movement of fluids into or between USDWs.

§ 146.65 Construction requirements.

(a) *General.* All existing and new Class I hazardous waste injection wells shall be constructed and completed to:

(1) Prevent the movement of fluids into or between USDWs or into any unauthorized zones;

(2) Permit the use of appropriate testing devices and workover tools; and

(3) Permit continuous monitoring of injection tubing and long string casing as required pursuant to §146.67(f).

(b) *Compatibility.* All well materials must be compatible with fluids with which the materials may be expected to come into contact. A well shall be deemed to have compatibility as long as the materials used in the construction of the well meet or exceed standards developed for such materials by the American Petroleum Institute, The American Society for Testing Materials, or comparable standards acceptable to the Director.

(c) *Casing and Cementing of New Wells.* (1) Casing and cement used in the construction of each newly drilled well shall be designed for the life expectancy of the well, including the post-closure care period. The casing and cementing program shall be designed to prevent the movement of fluids into or between USDWs, and to prevent potential leaks of fluids from the well. In determining and specifying casing and cementing requirements, the Director shall consider the following information as required by § 146.70:

(i) Depth to the injection zone;

(ii) Injection pressure, external pressure, internal pressure and axial loading;

(iii) Hole size;

(iv) Size and grade of all casing strings (well thickness, diameter, nominal weight, length, joint specification and construction material);

(v) Corrosiveness of injected fluid, formation fluids and temperature;

(vi) Lithology of injection and confining zones;

(vii) Type or grade of cement; and

(viii) Quantity and chemical composition of the injected fluid.

(2) One surface casing string shall, at a minimum, extend into the confining bed below the lowest formation that contains a USDW and be cemented by circulating cement from the base of the casing to the surface, using a minimum of 120% of the calculated annual volume. The Director may require more than 120% when the geology or other circumstances warrant it.

(3) At least one long string casing, using a sufficient number of centralizers, shall extend to the injection zone and

shall be cemented by circulating cement to the surface in one or more stages:

(i) Of sufficient quantity and quality to withstand the maximum operating pressure; and

(ii) In a quantity no less than 120% of the calculated volume necessary to fill the annular space. The Director may require more than 120% when the geology or other circumstances warrant it.

(4) Circulation of cement may be accomplished by staging. The Director may approve an alternative method of cementing in cases where the cement cannot be recirculated to the surface, provided the owner or operator can demonstrate by using logs that the cement is continuous and does not allow fluid movement behind the well bore.

(5) Casings, including any casing connections, must be rated to have sufficient structural strength to withstand, for the design life of the well:

(i) The maximum burst and collapse pressures which may be experienced during the construction, operation and closure of the well; and

(ii) The maximum tensile stress which may be experienced at any point along the length of the casing during the construction, operation, and closure of the well.

(6) At a minimum, cement and cement additivies must be of sufficient quality and quantity to maintain integrity over the design life of the well.

(d) *Tubing and packer.* (1) All Class I hazardous waste injection wells shall inject fluids through tubing with a packer set at a point specified by the Director.

(2) In determining and specifying requirements for tubing and packer, the following factors shall be considered:

(i) Depth of setting;

(ii) Characteristics of injection fluid (chemical content, corrosiveness, temperature and density);

(iii) Injection pressure;

(iv) Annular pressure;

(v) Rate (intermittent or continuous), temperature and volume of injected fluid;

(vi) Size of casing; and

(vii) Tubing tensile, burst, and collapse strengths.

(3) The Director may approve the use of a fluid seal if he determines that the following conditions are met:

(i) The operator demonstrates that the seal will provide a level of protection comparable to a packer;

(ii) The operator demonstrates that the staff is, and will remain, adequately trained to operate and maintain the well and to identify and interpret variations in parameters of concern;

(iii) The permit contains specific limitations on variations in annular pressure and loss of annular fluid;

(iv) The design and construction of the well allows continuous monitoring of the annular pressure and mass balance of annular fluid; and

(v) A secondary system is used to monitor the interface between the annulus fluid and the injection fluid and the permit contains requirements for testing the system every three months and recording the results.

§ 146.66 Logging, sampling, and testing prior to new well operation.

(a) During the drilling and construction of a new Class I hazardous waste injection well, appropriate logs and tests shall be run to determine or verify the depth, thickness, porosity, permeability, and rock type of, and the salinity of any entrained fluids in, all relevant geologic units to assure conformance with performance standards in § 146.65, and to establish accurate baseline data against which future measurements may be compared. A descriptive report interpreting results of such logs and tests shall be prepared by a knowledgeable log analyst and submitted to the Director. At a minimum, such logs and tests shall include:

(1) Deviation checks during drilling on all holes constructed by drilling a pilot hole which are enlarged by reaming or another method. Such checks shall be at sufficiently frequent intervals to determine the location of the borehole and to assure that vertical avenues for fluid movement in the form of diverging holes are not created during drilling; and

(2) Such other logs and tests as may be needed after taking into account the availability of similar data in the area of the drilling site, the construction plan, and the need for additional information that may arise from time to time as the construction of the well progresses. At a minimum, the following logs shall be required in the following situations:

(i) Upon installation of the surface casing:

(A) Resistivity, spontaneous potential, and caliper logs before the casing is installed; and

(B) A cement bond and variable density log, and a temperature log after the casing is set and cemented.

(ii) Upon installation of the long string casing:

(A) Resistivity, spontaneous potential, porosity, caliper, gamma ray, and fracture finder logs before the casing is installed; and

(B) A cement bond and variable density log, and a temperature log after the casing is set and cemented.

(iii) The Director may allow the use of an alternative to the above logs when an alternative will provide equivalent or better information; and

(3) A mechanical integrity test consisting of:

(i) A pressure test with liquid or gas;

(ii) A radioactive tracer survey;

(iii) A temperature or noise log;

(iv) A casing inspection log, if required by the Director; and

(v) Any other test required by the Director.

(b) Whole cores or sidewall cores of the confining and injection zones and formation fluid samples from the injection zone shall be taken. The Director may accept cores from nearby wells if the owner or operator can demonstrate that core retrieval is not possible and that such cores are representative of conditions at the well. The Director may require the owner or operator to core other formations in the borehole.

(c) The fluid temperature, pH, conductivity, pressure and the static fluid level of the injection zone must be recorded.

(d) At a minimum, the following information concerning the injection and confining zones shall be determined or calculated for Class I hazardous waste injection wells:

(1) Fracture pressure;

(2) Other physical and chemical characteristics of the injection and confining zones; and

(3) Physical and chemical characteristics of the formation fluids in the injection zone.

(e) Upon completion, but prior to operation, the owner or operator shall conduct the following tests to verify hydrogeologic characteristics of the injection zone:

(1) A pump test; or

(2) Injectivity tests.

(f) The Director shall have the opportunity to witness all logging and testing by this Subpart. The owner or operator shall submit a schedule of such activities to the Director 30 days prior to conducting the first test.

§ 146.67 Operating requirements.

(a) Except during stimulation, the owner or operator shall assure that injection pressure at the wellhead does not exceed a maximum which shall be calculated so as to assure that the pressure in the injection zone during injection does not initiate new fractures or propagate existing fractures in the injection zone. The owner or operator shall assure that the injection pressure does not initiate fractures or propagate existing fractures in the confining zone.

nor cause the movement of injection or formation fluids into a USDW.

(b) Injection between the outermost casing protecting USDWs and the well bore is prohibited.

(c) The owner or operator shall maintain an annulus pressure that exceeds the operating injection pressure, unless the Director determines that such a requirement might harm the integrity of the well. The fluid in the annulus shall be noncorrosive, or shall contain a corrosion inhibitor.

(d) The owner or operator shall maintain mechanical integrity of the injection well at all times.

(e) Permit requirements for owners or operators of hazardous waste wells which inject wastes which have the potential to react with the injection formation to generate gases shall include:

(1) Conditions limiting the temperature, pH or acidity of the injected waste; and

(2) Procedures necessary to assure that pressure imbalances which might cause a backflow or blowout do not occur.

(f) The owner or operator shall install and use continuous recording devices to monitor: the injection pressure; the flow rate, volume, and temperature of injected fluids; and the pressure on the annulus between the tubing and the long string casing, and shall install and use:

(1) Automatic alarm and automatic shut-off systems, designed to sound and shut-in the well when pressures and flow rates or other parameters approved by the Director exceed a range and/or gradient specified in the permit; or

(2) Automatic alarms, designed to sound when the pressures and flow rates or other parameters approved by the Director exceed a rate and/or gradient specified in the permit, in cases where the owner or operator certifies that a trained operator will be on-site at all times when the well is operating.

(g) If an automatic alarm or shutdown is triggered, the owner or operator shall immediately investigate and identify as expeditiously as possible the cause of the alarm or shutoff. If, upon such investigation, the well appears to be lacking mechanical integrity, or if monitoring required under paragraph (f) of this section otherwise indicates that the well may be lacking mechanical integrity, the owner or operator shall:

(1) Cease injection of waste fluids unless authorized by the Director to continue or resume injection.

(2) Take all necessary steps to determine the presence or absence of a leak; and

(3) Notify the Director within 24 hours after the alarm or shutdown.

(h) If a loss of mechanical integrity is discovered pursuant to paragraph (g) of this section or during periodic mechanical integrity testing, the owner or operator shall:

(1) Immediately cease injection of waste fluids;

(2) Take all steps reasonably necessary to determine whether there may have been a release of hazardous wastes or hazardous waste constituents into any unauthorized zone;

(3) Notify the Director within 24 hours after loss of mechanical integrity is discovered;

(4) Notify the Director when injection can be expected to resume; and

(5) Restore and demonstrate mechanical integrity to the satisfaction of the Director prior to resuming injection of waste fluids.

(i) Whenever the owner or operator obtains evidence that there may have been a release of injected wastes into an unauthorized zone:

(1) The owner or operator shall immediately case injection of waste fluids, and:

(i) Notify the Director within 24 hours of obtaining such evidence;

(ii) Take all necessary steps to identify and characterize the extent of any release;

(iii) Comply with any remediation plan specified by the Director;

(iv) Implement any remediation plan approved by the Director; and

(v) Where such release is into a USDW currently serving as a water supply, place a notice in a newspaper of general circulation.

(2) The Director may allow the operator to resume injection prior to completing cleanup action if the owner or operator demonstrates that the injection operation will not endanger USDWs.

(j) The owner or operator shall notify the Director and obtain his approval prior to conducting any well workover.

§ 146.68 Testing and monitoring requirements.

Testing and monitoring requirements shall at a minimum include:

(a) Monitoring of the injected wastes. (1) The owner or operator shall develop and follow an approved written waste analysis plan that describes the procedures to be carried out to obtain a detailed chemical and physical analysis of a representative sample of the waste, including the quality assurance procedures used. At a minimum, the plan shall specify:

(i) The paramenters for which the waste will be analyzed and the rationale for the selection of these parameters;

(ii) The test methods that will be used to test for these parameters; and

(iii) The sampling method that will be used to obtain a representative sample of the waste to be analyzed.

(2) The owner or operator shall repeat the analysis of the injected wastes as described in the waste analysis plan at frequencies specified in the waste analysis plan and when process or operating changes occur that may significantly alter the characteristics of the waste stream.

(3) The owner or operator shall conduct continuous or periodic monitoring of selected parameters as required by the Director.

(4) The owner or operator shall assure that the plan remains accurate and the analyses remain representative.

(b) Hydrogeologic compatibility determination. The owner or operator shall submit information demonstrating to the satisfaction of the Director that the waste stream and its anticipated reaction products will not alter the permeability, thickness or other relevant characteristics of the confining or injection zones such that they would no longer meet the requirements specified in § 146.62.

(c) Compatibility of well materials. (1) The owner or operator shall demonstrate that the waste stream will be compatible with the well materials with which the waste is expected to come into contact, and submit to the Director a description of the methodology used to make that determination. Compatibility for purposes of this requirement is established if contact with injected fluids will not cause the well materials to fail to satisfy any design requirement imposed under § 146.65(b).

(2) The Director shall require continuous corrosion monitoring of the construction materials used in the well for wells injecting corrosive waste, and may require such monitoring for other waste, by:

(i) Placing coupons of the well construction materials in contact with the waste stream; or

(ii) Routing the waste stream through a loop constructed with the material used in the well; or

(iii) Using an alternative method approved by the Director.

(3) If a corrosion monitoring program is required:

(i) The test shall use materials identical to those used in the construction of the well, and such materials must be continuously exposed to the operating pressures and temperatures (measured at the well

head) and flow rates of the injection operation; and

(ii) The owner or operator shall monitor the materials for loss of mass, thickness, cracking, pitting and other signs of corrosion on a quarterly basis to ensure that the well components meet the minimum standards for material strength and performance set forth in § 146.65(b).

(d) *Periodic mechanical integrity testing.* In fulfilling the requirements of § 146.8, the owner or operator of a Class I hazardous waste injection well shall conduct the mechanical integrity testing as follows:

(1) The long string casing, injection tube, and annular seal shall be tested by means of an approved pressure test with a liquid or gas annually and whenever there has been a well workover;

(2) The bottom-hole cement shall be tested by means of an approved radioactive tracer survey annually;

(3) An approved temperature, noise, or other approved log shall be run at least once every five years to test for movement of fluid along the borehole. The Director may require such tests whenever the well is worked over;

(4) Casing inspection logs shall be run at least once every five years unless the Director waives this requirement due to well construction or other factors which limit the test's reliability; and

(5) Any other test approved by the Director in accordance with the procedures in § 146.8(d) may also be used.

(e) Ambient monitoring. (1) Based on a site-specific assessment of the potential for fluid movement from the well or injection zone, and on the potential value of monitoring wells to detect such movement, the Director shall require the owner or operator to develop a monitoring program. At a minimum, the Director shall require monitoring of the pressure buildup in the injection zone annually, including at a minimum, a shut down of the well for a time sufficient to conduct a valid observation of the pressure fall-off curve.

(2) When prescribing a monitoring system the Director may also require:

(i) Continuous monitoring for pressure changes in the first aquifer overlying the confining zone. When such a well is installed, the owner or operator shall, on a quarterly basis, sample the aquifer and analyze for constituents specified by the Director;

(ii) The use of indirect, geophysical techniques to determine the position of the waste front, the water quality in a formation designated by the Director, or to provide other site specific data;

(iii) Periodic monitoring of the ground water quality in the first aquifer overlying the injection zone;

(iv) Periodic monitoring of the ground water quality in the lowermost USDW; and

(v) Any additional monitoring necessary to determine whether fluids are moving into or between USDWs.

(f) The Director may require seismicity monitoring when he has reason to believe that the injection activity may have the capacity to cause seismic distrubances.

§ 146.69 Reporting requirements.

Reporting requirements shall, at a minimum, include:

(a) Quarterly reports to the Director containing:

(1) The maximum injection pressure;

(2) A description of any event that exceeds operating parameters for annulus pressure or injection pressure as specified in the permit;

(3) A description of any event which triggers an alarm or shutdown device required pursuant to § 146.67(f) and the response taken;

(4) The total volume of fluid injected;

(5) Any change in the annular fluid volume;

(6) The physical, chemical and other relevant characteristics of injected fluids; and

(7) The results of monitoring prescribed under § 146.68.

(b) Reporting, within 30 days or with the next quarterly report whichever comes later, the results of:

(1) Periodic tests of mechanical integrity;

(2) Any other test of the injection well conducted by the permittee if required by the Director; and

(3) Any well workover.

§ 146.70 Information to be evaluated by the Director.

This section sets forth the information which must be evaluated by the Director in authorizing Class I hazardous waste injection wells. For a new Class I hazardous waste injection well, the owner or operator shall submit all the information listed below as part of the permit application. For an existing or converted Class I hazardous waste injection well, the owner or operator shall submit all information listed below as part of the permit application except for those items of information which are current, accurate, and available in the existing permit file. For both existing and new Class I hazardous waste injection wells, certain maps, cross-sections, tabulations of wells within the area of review and other data may be included in the application by reference provided they are current and readily available to the Director (for example, in the permitting agency's files) and sufficiently identifiable to be retrieved. In cases where EPA issues the permit, all the information in this section must be submitted to the Administrator or his designee.

(a) Prior to the issuance of a permit for an existing Class I hazardous waste injection well to operate or the construction or conversion of a new Class I hazardous waste injection well, the Director shall review the following to assure that the requirements of this Part and Part 144 are met:

(1) Information required in § 144.31;

(2) A map showing the injection well for which a permit is sought and the applicable area of review. Within the area of review, the map must show the number or name and location of all producing wells, injection wells, abandoned wells, dry holes, surface bodies of water, springs, mines (surface and subsurface), quarries, water wells and other pertinent surface features, including residences and roads. The map should also show faults, if known or suspected;

(3) A tabulation of all wells within the area of review which penetrate the proposed injection zone or confining zone. Such data shall include a description of each well's type, construction, date drilled, location, depth, record of plugging and/or completion and any additional information the Director may require;

(4) The protocol followed to identify, locate and ascertain the condition of abandoned wells within the area of review which penetrate the injection or the confining zones;

(5) Maps and cross-sections indicating the general vertical and lateral limits of all underground sources of drinking water within the area of review, their position relative to the injection formation and the direction of water movement, where known, in each underground source of drinking water which may be affected by the proposed injection;

(6) Maps and cross-sections detailing the geologic structure of the local area;

(7) Maps and cross-sections illustrating the regional geologic setting;

(8) Proposed operating data;

(i) Average and maximum daily rate and volume of the fluid to be injected; and

(ii) Average and maximum injection pressure;

(9) Proposed formation testing program to obtain an analysis of the chemical, physical and radiological characteristics of and other information

on the injection formation and the confining zone;

(10) Proposed stimulation program;

(11) Proposed injection procedure;

(12) Schematic or other appropriate drawings of the surface and subsurface construction details of the well;

(13) Contingency plans to cope with all shut-ins or well failures so as to prevent migration of fluids into any USDW;

(14) Plans (including maps) for meeting monitoring requirements of § 146.68;

(15) For wells within the area of review which penetrate the injection zone or the confining zone but are not properly completed or plugged, the corrective action to be taken under § 146.64;

(16) Construction procedures including a cementing and casing program, well materials specifications and their life expectancy, logging procedures, deviation checks, and a drilling, testing and coring program; and

(17) A demonstration pursuant to Part 144, Subpart F, that the applicant has the resources necessary to close, plug or abandon the well and for post-closure care.

(b) Prior to the Director's granting approval for the operation of a Class I hazardous waste injection well, the owner or operator shall submit and the Director shall review the following information, which shall be included in the completion report:

(1) All available logging and testing program data on the well;

(2) A demonstration of mechanical integrity pursuant to § 146.68;

(3) The anticipated maximum pressure and flow rate at which the permittee will operate;

(4) The results of the injection zone and confining zone testing program as required in § 146.70(a)(9);

(5) The actual injection procedure;

(6) The compatibility of injected waste with fluids in the injection zone and minerals in both the injection zone and the confining zone and with the materials used to construct the well;

(7) The calculated area of review based on data obtained during logging and testing of the well and the formation, and where necessary revisions to the information submitted under § 146.70(a) (2) and (3).

(8) The status of corrective action on wells identified in § 146.70(a)(15).

(c) Prior to granting approval for the plugging and abandonment (i.e., closure) of a Class I hazardous waste injection well, the Director shall review the information required in §§ 146.71(a)(4) and 146.72(a).

(d) Any permit issued for a Class I hazardous waste injection well for disposal on the premises where the waste is generated shall contain a certification by the owner or operator that:

(1) The generator of the hazardous waste has a program to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to be economically practicable; and

(2) Injection of the waste is that practicable method of disposal currently available to the generator which minimizes the present and future threat to human health and the environment.

§ 146.71 Closure

(a) *Closure Plan.* The owner or operator of a Class I hazardous waste injection well shall prepare, maintain, and comply with a plan for closure of the well that meets the requirements of paragraph (d) of this section and is acceptable to the Director. The obligation to implement the closure plan survives the termination of a permit or the cessation of injection activities. The requirement to maintain and implement an approved plan is directly enforceable regardless of whether the requirement is a condition of the permit.

(1) The owner or operator shall submit the plan as a part of the permit application and, upon approval by the Director, such plan shall be a condition of any permit issued.

(2) The owner or operator shall submit any proposed significant revision to the method of closure reflected in the plan for approval by the Director no later than the date on which notice of closure is required to be submitted to the Director under paragraph (b) of this section.

(3) The plan shall assure financial responsibility as required in § 144.52(a)(7).

(4) The plan shall include the following information:

(i) The type and number of plugs to be used;

(ii) The placement of each plug including the elevation of the top and bottom of each plug;

(iii) The type and grade and quantity of material to be used in plugging;

(iv) The method of placement of the plugs;

(v) Any proposed test or measure to be made;

(vi) The amount, size, and location (by depth) of casing and any other materials to be left in the well;

(vii) The method and location where casing is to be parted, if applicable;

(viii) The procedure to be used to meet the requirements of paragraph (d)(5) of this section;

(ix) The estimated cost of closure; and

(x) Any proposed test or measure to be made.

(5) The Director may modify a closure plan following the procedures of § 124.5.

(6) An owner or operator of a Class I hazardous waste injection well who ceases injection temporarily, may keep the well open provided he:

(i) Has received authorization from the Director; and

(ii) Has described actions or procedures, satisfactory to the Director, that the owner or operator will take to ensure that the well will not endanger USDWs during the period of temporary disuse. These actions and procedures shall include compliance with the technical requirements applicable to active injection wells unless waived by the Director.

(7) The owner or operator of a well that has ceased operations for more than two years shall notify the Director 30 days prior to resuming operation of the well.

(b) *Notice of intent to close.* The owner or operator shall notify the Director at least 60 days before closure of a well. At the discretion of the Director, a shorter notice period may be allowed.

(c) *Closure report.* Within 60 days after closure or at the time of the next quarterly report (whichever is less) the owner or operator shall submit a closure report to the Director. If the quarterly report is due less than 15 days after completion of closure, then the report shall be submitted within 60 days after closure. The report shall be certified as accurate by the owner or operator and by the person who performed the closure operation (if other than the owner or operator). Such report shall consist of either: (1) A statement that the well was closed in accordance with the closure plan previously submitted and approved by the Director; or

(2) Where actual closure differed from the plan previously submitted, a written statement specifying the differences between the previous plan and the actual closure.

(d) *Standards for well closure.* (1) Prior to closing the well, the owner or operator shall observe and record the pressure decay for a time specified by the Director. The Director shall analyze the pressure decay and the transient pressure observations conducted pursuant to § 146.68(e)(1)(i) and determine whether the injection activity has conformed with predicted values.

(2) Prior to well closure, appropriate mechanical integrity testing shall be conducted to ensure the integrity of that portion of the long string casing and cement that will be left in the ground after closure. Testing methods may include:

(i) Pressure tests with liquid or gas;

(ii) Radioactive tracer surveys;

(iii) Noise, temperature, pipe evaluation, or cement bond logs; and

(iv) Any other test required by the Director.

(3) Prior to well closure, the well shall be flushed with a buffer fluid.

(4) Upon closure, a Class I hazardous waste well shall be plugged with cement in a manner that will not allow the movement of fluids into or between USDWs.

(5) Placement of the cement plugs shall be accomplished by one of the following:

(i) The Balance Method;

(ii) The Dump Bailer Method;

(iii) The Two-Plug Method; or

(iv) An alternate method, approved by the Director, that will reliably provide a comparable level of protection.

(6) Each plug used shall be appropriately tagged and tested for seal and stability before closure is completed.

(7) The well to be closed shall be in a state of static equilibrium with the mud weight equalized top to bottom, either by circulating the mud in the well at least once or by a comparable method prescribed by the Director, prior to the placement of the cement plug(s).

§ 146.72 Post-closure care.

(a) The owner or operator of a Class I hazardous waste well shall prepare, maintain, and comply with a plan for post-closure care that meets the requirements of paragraph (b) of this section and is acceptable to the Director. The obligation to implement the post-closure plan survives the termination of a permit or the cessation of injection activities. The requirement to maintain an approved plan is directly enforceable regardless of whether the requirement is a condition of the permit.

(1) The owner or operator shall submit the plan as a part of the permit application and, upon approval by the Director, such plan shall be a condition of any permit issued.

(2) The owner or operator shall submit any proposed significant revision to the plan as appropriate over the life of the well, but no later than the date of the closure report required under § 146.71(c).

(3) The plan shall assure financial responsibility as required in § 146.73.

(4) The plan shall include the following information:

(i) The pressure in the injection zone before injection began;

(ii) The anticipated pressure in the injection zone at the time of closure;

(iii) The predicted time until pressure in the injection zone decays to the point that the well's cone of influence no longer intersects the base of the lowermost USDW;

(iv) Predicted position of the waste front at closure;

(v) The status of any cleanups required under § 146.64; and

(vi) The estimated cost of proposed post-closure care.

(5) At the request of the owner or operator, or on his own initiative, the Director may modify the post-closure plan after submission of the closure report following the procedures in § 124.5.

(b) The owner or operator shall:

(1) Continue and complete any cleanup action required under § 146.64, if applicable;

(2) Continue to conduct any groundwater monitoring required under the permit until pressure in the injection zone decays to the point that the well's cone of influence no longer intersects the base of the lowermost USDW. The Director may extend the period of post-closure monitoring if he determines that the well may endanger a USDW.

(3) Submit a survey plat to the local zoning authority designated by the Director. The plat shall indicate the location of the well relative to permanently surveyed benchmarks. A copy of the plat shall be submitted to the Regional Administrator of the appropriate EPA Regional Office.

(4) Provide appropriate notification and information to such State and local authorities as have cognizance over drilling activities to enable such State and local authorities to impose appropriate conditions on subsequent drilling activities that may penetrate the well's confining or injection zone.

(5) Retain, for a period of three years following well closure, records reflecting the nature, composition and volume of all injected fluids. The Director shall require the owner or operator to deliver the records to the Director at the conclusion of the retention period, and the records shall thereafter be retained at a location designated by the Director for that purpose.

(c) Each owner of a Class I hazardous waste injection well, and the owner of the surface or subsurface property on or in which a Class I hazardous waste injection well is located, must record a notation on the deed to the facility property or on some other instrument which is normally examined during title search that will in perpetuity provide any potential purchaser of the property the following information:

(1) The fact that land has been used to manage hazardous waste;

(2) The name of the State agency or local authority with which the plat was filed, as well as the address of the Regional Environmental Protection Agency Office to which it was submitted;

(3) The type and volume of waste injected, the injection interval or intervals into which it was injected, and the period over which injection occurred.

§ 146.73 Financial responsibility for post-closure care.

The owner or operator shall demonstrate and maintain financial responsibility for post-closure by using a trust fund, surety bond, letter of credit, financial test, insurance or corporate guarantee that meets the specifications for the mechanisms and instruments revised as appropriate to cover closure and post-closure care in 40 CFR Part 144, Subpart F. The amount of the funds available shall be no less than the amount identified in § 146.72(a)(4)(vi). The obligation to maintain financial responsibility for post-closure care survives the termination of a permit or the cessation of injection. The requirement to maintain financial responsibility is enforceable regardless of whether the requirement is a condition of the permit.

Part 148 is added to read as follows:

PART 148—HAZARDOUS WASTE INJECTION RESTRICTIONS

Subpart A—General

Sec.

Subpart B—Prohibitions on Injection

Subpart C—Petition Standards and Procedures

Authority: Secs. 3004, Resource Conservation and Recovery Act, 42 U.S.C. 6901 *et seq.*

Subpart A—General

§ 148.1 Purpose, scope and applicability.

(a) This part identifies hazardous wastes that are restricted from disposal into Class I hazardous waste injection wells and defines those circumstances under which a waste, otherwise prohibited from injection, may be injected.

(b) The requirements of this part apply to owners or operators of Class I hazardous waste injection wells used to inject hazardous waste.

(c) Wastes otherwise prohibited from injection may continue to be injected:

(1) If an extension from the effective date of a prohibition has been granted pursuant to § 148.4 with respect to such wastes; or

(2) If an exemption from a prohibition has been granted in response to a petition filed under § 148.20 to allow injection of restricted wastes with respect to those wastes and wells covered by the exemption; or

(3) If the waste is generated by a conditionally exempt small quantity generator, as defined in § 261.5; or

(4) Until November 8, 1988, if the waste has been determined to be contaminated soil or debris resulting from a response action taken under section 104 or 106 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 or a corrective action required under the Resource Conservation and Recovery Act.

§ 148.2 Definitions.

Injection interval means that part of the injection zone in which the well is screened, or in which the waste is otherwise directly emplaced.

Transmissive fault or fracture is a fault or fracture that has sufficient permeability and vertical extent to allow fluids to move between formations.

§ 148.3 Dilution prohibited as a substitute for treatment.

The prohibition of § 268.3 shall apply to owners or operators of Class I hazardous waste injection wells.

§ 148.4 Procedures for case-by-case extensions to an effective date.

The owner or operator of a Class I hazardous waste injection well may submit an application to the Administrator for an extension of the effective date of any applicable prohibition established under Subpart B of this Part according to the procedures of § 268.5.

§ 148.5 Waste analysis.

Generators of hazardous wastes that are disposed of into Class I injection wells must comply with the applicable requirements of § 268.7 (a) and (b). Owners or operators of Class I hazardous waste injection wells must comply with the applicable requirements of § 268.7(c).

Subpart B—Prohibitions on Injection

§ 148.10 Waste specific prohibitions—solvent wastes.

(a) Effective August 8, 1988, the spent solvent wastes specified in § 261.31 as EPA Hazardous Waste Nos. F001, F002, F003, F004, and F005 are prohibited from underground injection unless the solvent waste is a solvent-water mixture or solvent-containing sludge containing less than 1 percent total F001–F005 solvent constituents listed in Table A of this section.

(b) Effective August 8, 1990, all spent F001–F005 solvent wastes containing less than 1 percent total F001–F005 solvent constituents listed in Table A of this section are prohibited from injection.

(c) The requirements of paragraphs (a) and (b) of this section do not apply:

(1) If the wastes meet or are treated to meet the standards of § 268.41; or

(2) If an exemption from a prohibition has been granted in response to a petition under Subpart C of this Part; or

(3) During the period of extension of the applicable effective date if an extension has been granted under § 148.4 of this Part; or

(4) During the period the waste has been granted a treatability variance under § 268.44.

Table A

Acetone
n-Butyl alcohol
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Cresols and cresylic acid
Cyclohexanone
1,2-dichlorobenzene
Ethyl acetate
Ethyl benzene
Ethyl ether
Isobutanol
Methanol
Methylene chloride
Methylene chloride (from the pharmaceutical industry)
Methyl ethyl ketone
Methyl isobutyl ketone
Nitrobenzene
Pyridine
Tetrachloroethylene
Toluene
1,1,1-Trichloroethane
1,2,2-Trichloro-1,2,2 trifluoroethane
Trichloroethylene
Trichlofluoromethane
Xylene

§ 148.11 Waste specific prohibitions—dioxin-containing wastes.

(a) Effective August 8, 1988, the dioxin-containing wastes specified in § 261.31 as EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, F027, and F028, and prohibited from underground injection.

(b) The requirements of paragraph (a) of this section do not apply:

(1) If the wastes meet or are treated to meet the standards of § 268.41; or

(2) If an exemption from a prohibition has been granted in response to a petition under Subpart C of this Part; or

(3) During the period of extension of the applicable effective date of an extension has been granted under § 148.4 of this Part; or

(4) During the period the waste has been granted a treatability variance under § 268.44.

Subpart C—Petition Standards and Procedures

§ 148.20 Petitions to allow injection of a waste prohibited under Subpart B.

(a) Any person seeking an exemption from a prohibition under Subpart B of this part for the injection of a restricted hazardous waste into an injection well or wells shall submit a petition to the Director demonstrating that, to a reasonable degree of certainty, there will be no migration of hazardous constituents from the injection zone for as long as the waste remains hazardous. This demonstration requires a showing that:

(1) The hydrogeological and geochemical conditions at the sites and the physiochemical nature of the waste stream(s) are such that reliable predictions can be made that:

(i) Fluid movement conditions are such that the injected fluids will not migrate within 10,000 years:

(A) Vertically upward out of the injection zone; or

(B) Laterally within the injection zone to a point of discharge or interface with an Underground Source of Drinking Water (USDW) as defined in 40 CFR Part 146; or

(ii) Before the injected fluids migrate out of the injection zone or to a point of discharge or interface with USDW, the fluid will no longer be hazardous because of attenuation, transformation, or immobilization of hazardous constituents within the injection zone by hydrolysis, chemical interactions or other means; and

(2) For each well the petition has:

(i) Demonstrated that the injection well's area of review complies with the substantive requirements of § 146.63;

(ii) Located, identified, and ascertained the condition of all wells within the injection well's area of review (as specified in § 146.63) that penetrate the injection zone or the confining zone by use of a protocol acceptable to the Director that meets the substantive requirements of § 146.64;

(iii) Submitted a corrective action plan that meets the substantive requirements of § 146.64, the implementation of which shall become a condition of petition approval; and

(iv) Submitted the results of pressure and radioactive tracer tests performed within one year prior to submission of the petition demonstrating the mechanical integrity of the well's long string casing, injection tube, annular seal, and bottom hole cement. In cases where the petition has not been approved or denied within one year after the initial demonstration of mechanical integrity, the Director may require the owner or operator to perform the tests again and submit the results of the new tests.

Note.—The requirements of § 148.20(a)(2) need not be incorporated in a permit at the time of petition approval.

(b) A demonstration under § 148.20(a)(1)(i) shall identify the strata within the injection zone which will confine fluid movement above the injection interval and include a showing that this strata is free of known transmissive faults of fractures and that there is a confining zone above the injection zone.

(c) A demonstration under § 148.20(a)(1)(ii) shall identify the strata within the injection zone where waste transformation will be accomplished and include a showing that this strata is free of known transmissive faults or fractures and that there is a confining zone above the injection zone.

(d) A demonstration may include a showing that:

(1) Treatment methods, the implementation of which shall become a condition of petition approval, will be utilized that reduce the toxicity or mobility of the wastes; or

(2) A monitoring plan, the implementation of which shall become a condition of petition approval, will be utilized to enhance confidence in one or more aspects of the demonstration.

(e) Any person who has been granted an exemption pursuant to this section may submit a petition for reissuance of the exemption to include an additional restricted waste or wastes or to modify any conditions placed on the exemption by the Director. The Director shall reissue the petition if the petitioner complies with the requirements of paragraphs (a), (b) and (c) of this section.

(f) Any person who has been granted an exemption pursuant to this section may submit a petition to modify an exemption to include an additional (hazardous) waste or wastes. The Director may grant the modification if he determines, to a reasonable degree of certainty, that the additional waste or wastes will behave hydraulically and chemically in a manner similar to previously included wastes and that it will not interfere with the containment capability of the injection zone.

§ 148.21 Information to be submitted in support of petitions.

(a) Information submitted in support of § 148.20 must meet the following criteria:

(1) All waste analysis and any new testing performed by the petitioner shall be accurate and reproducible and performed in accordance with quality assurance standards;

(2) Estimation techniques shall be appropriate, and EPA-certified test protocols shall be used where available and appropriate;

(3) Predictive models shall have been verified and validated, shall be appropriate for the specific site, waste streams, and injection conditions of the operation, and shall be calibrated for existing sites where sufficient data are available;

(4) An approved quality assurance and quality control plan shall address all aspects of the demonstration;

(5) Reasonably conservative values shall be used whenever values taken from the literature or estimated on the basis of known information are used instead of site-specific measurements; and

(6) An analysis shall be performed to identify and assess aspects of the demonstration that contribute significantly to uncertainty. The petitioner shall conduct a sensitivity analysis to determine the effect that significant uncertainty may contribute to the demonstration. The demonstration shall then be based on conservative assumptions identified in the analysis.

(b) Any petitioner under § 148.20(a)(1)(i) shall provide sufficient site-specific information to support the demonstration, such as:

(1) Thickness, porosity, permeability and extent of the various strata in the injection zone;

(2) Thickness, porosity, permeability, extent, and continuity of the confining zone;

(3) Hydraulic gradient in the injection zone;

(4) Hydrostatic pressure in the injection zone; and

(5) Geochemical conditions of the site.

(c) In addition to the information in § 148.21(b), any petitioner under § 148.20(a)(1)(ii) shall provide sufficient waste-specific information to ensure reasonably reliant predictions about the waste transformation. The petitioner shall provide the information necessary to support the demonstration, such as:

(1) Description of the chemical processes or other means that will lead to waste transformation; and

(2) Results of laboratory experiments verifying the waste transformation.

§ 148.22 Requirements for petition submission, review and approval or denial.

(a) Any petition submitted to the Director pursuant to § 148.20(a) shall include the following components:

(1) An identification of the specific waste or wastes and the specific injection well or wells for which the demonstration will be made;

(2) A waste analysis to describe fully the chemical and physical characteristics of the subject wastes;

(3) Such additional information as is required by the Director to support the petition under §§148.20 and 148.21; and

(4) This statement signed by the petitioner or an authorized representative:

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this petition and all attached documents, and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

(b) The Director shall provide public notice and an opportunity for public comment in accordance with the procedures in §124.10 of the intent to approve or deny a petition. The final decision on a petition will be published in the **Federal Register.**

(c) If an exemption is granted it will apply only to the underground injection of the specifice restricted waste or wastes identified in the petition into a Class I hazardous waste injection well or wells specifically identified in the petition (unless the exemption is modified or reissued pursuant to § 148.20(e) or (f).

(d) Upon request by any petitioner who obtains an exemption for a well under this Subpart, the Director shall initiate and reasonably expedite the necessary procedures to issue or reissue a permit or permits for the hazardous waste well or wells covered by the exemption for a term not to exceed ten years.

§ 148.23 Review of exemptions granted pursuant to a petition.

(a) When considering whether to reissue a permit for the operation of a Class I hazardous waste injection well, the Director shall review any petition filed pursuant to § 148.20 and require a new demonstration if information shows that the basis for granting the exemption may no longer be valid.

(b) Whenever the Director determines that the basis for approval of a petition may no longer be valid, the Director shall require a new demonstration in accordance with § 148.20.

§ 148.24 Termination of approved petition.

(a) The Director may terminate an exemption granted under § 148.20 for the following causes:

(1) Noncompliance by the petitioner with any condition of the exemption;

(2) The petitioner's failure in the petition or during the review and approval to disclose fully all relevant facts, or the petitioner's misrepresentation of any relevant facts at any time; or

(3) A determination that new information shows that the basis for approval of the petition is no longer valid.

(b) The Director shall terminate an exemption granted under § 148.20 for the following causes:

(1) The petitioner's willful withholding during the review and approval of the petition of facts directly and materially relevant to the Director's decision on the petition;

(2) A determination that there has been migration from the injection zone or the well that is not in accordance with the terms of the exemption, except that the Director may at his discretion decide not to terminate where:

(i) The migration resulted from a mechanical failure of the well that can be corrected promptly through a repair to the injection well itself or from an undetected well or conduit that can be plugged promptly; and

(ii) The requirements of § 146.67(i) are satisfied.

(c) The Director shall follow the procedures in § 124.5 in terminating any exemption under this section.

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