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NUREG-0859

Compliance Determination Procedures for Environmental Radiation Protection Standards for Uranium Recovery Facilities 40 CFR Part 190

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards
Office of Nuclear Regulatory Research

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Division of Waste Management
Office of Nuclear Material Safety and Safeguards

Division of Health, Siting, and Waste Management
Office of Nuclear Regulatory Research
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Abstract

Uranium milling operations are licensed by the Nuclear Regulatory Commission and by some states in agreement with the Commission. The radiation dose to any individual from the operation of facilities within the uranium fuel cycle is limited to levels set by the Environmental Protection Agency. These levels are contained in the EPA Environmental Radiation Protection Standards for Nuclear Power Operations, in Part 190 of Title 40 of the Code of Federal Regulations (40 CFR Part 190). This report describes the procedures used within NRC's Uranium Recovery Licensing Branch for evaluating compliance with these regulations for uranium milling operations. The report contains descriptions of these procedures, dose factors for evaluating environmental measurement data, and guidance to the NRC staff reviewer.

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Title: Compliance Determination Procedures for Environmental Radiation Protection Standards for Uranium Recovery Facilities - 40 CFR Part 190

Background

Under Title 40 Part 190 of the Code of Federal Regulations, the U.S. Environmental Protection Agency (EPA) promulgated "Environmental Radiation Protection Standards for Nuclear Power Operations" (Reference 1). These standards contain limits for the radiation doses received by members of the public in the general environment as the result of operations which are part of the nuclear fuel cycle. The EPA standards, which became effective for uranium milling operations on December 1, 1980, require each uranium milling facility* to conduct its operations in such a manner to assure that the annual radiation dose equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public is not exceeded. However, the dose from radon and its daughters is excluded from these doses. The following discussion briefly describes the Nuclear Regulatory Commission's (NRC) program for compliance determination for uranium recovery facilities. In March 1981, the NRC published amendments to 10 CFR Part 20 entitled "Environmental Radiation Protection Standards for Nuclear Power Operations" (Reference 2) which require that an NRC licensee shall comply with 40 CFR Part 190.

Radiological assessments performed in the uranium milling generic environmental impact statement (GEIS) show that 40 CFR Part 190 compliance can be achieved only by strict emission controls at the mill. The most significant sources of emissions are the tailings ponds, tailings piles and the yellowcake dryer stacks. The NRC has made strict emission control a specific license condition in its licensing activities over the past several years and it has been an NRC requirement that exposure limits be met by emission controls to the maximum extent reasonably achievable. Such emission control requirements are contained in the May 1977 NRC staff position on "Tailings Management Performance Objectives" and in the final regulations on uranium milling issued in the Federal Register on October 3, 1980. The criteria in these regulations covering emission controls are contained in Appendix B. Land use control, e.g., expanding the buffer zone around a mill site, cannot exclusively be used as a substitute for reducing actual emissions from the various milling processes. The primary means of meeting exposure limits must be by emission control.

There are inherent problems in accurately determining source terms, particularly from large area sources such as the tailings impoundments. Also, there are significant uncertainties in the atmospheric transport models used to compute

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* All uranium extraction facilities; to include mills, in situ operations and heap leach facilities. R&D facilities are not included here since initial assessments indicate that their size and potential radiological impact are insignificant (e.g., R&D in situ operations in general have no airborne particulate releases). However, the Edgemont mill site and the other sites selected for remedial actions for the cleanup of mill tailings (i.e., at abandoned mill sites or offsite areas where tailings have been used) are excluded from 40 CFR Part 190 compliance during the remedial action work phase.

airborne radioactivity concentrations given a source term, particularly where there is irregular terrain. Therefore, the primary means of determining compliance must be by measurements made at the point of an actual individual receptor, and the procedures outlined below reflect this. Environmental measurements at other locations near the mill and at background locations, effluent sampling, meteorologic data, and other similar information should be available to supplement data from the single point where the receptor is located. Such supplemental information is required most in cases where computed doses approach or exceed the limit. Other monitoring data will be necessary, for example, to screen out effects of mines that may be nearby and may be contributing to dose. Effluents from mines are not to be included in dose assessments for compliance with 40 CFR Part 190 as that regulation does not apply to mining operations.

Assertion that mill operations utilize emission controls will not in itself suffice to show compliance with 40 CFR Part 190 exposure limits. Dose assessments based on actual environmental monitoring data are required and should be compatible with the procedures discussed below.

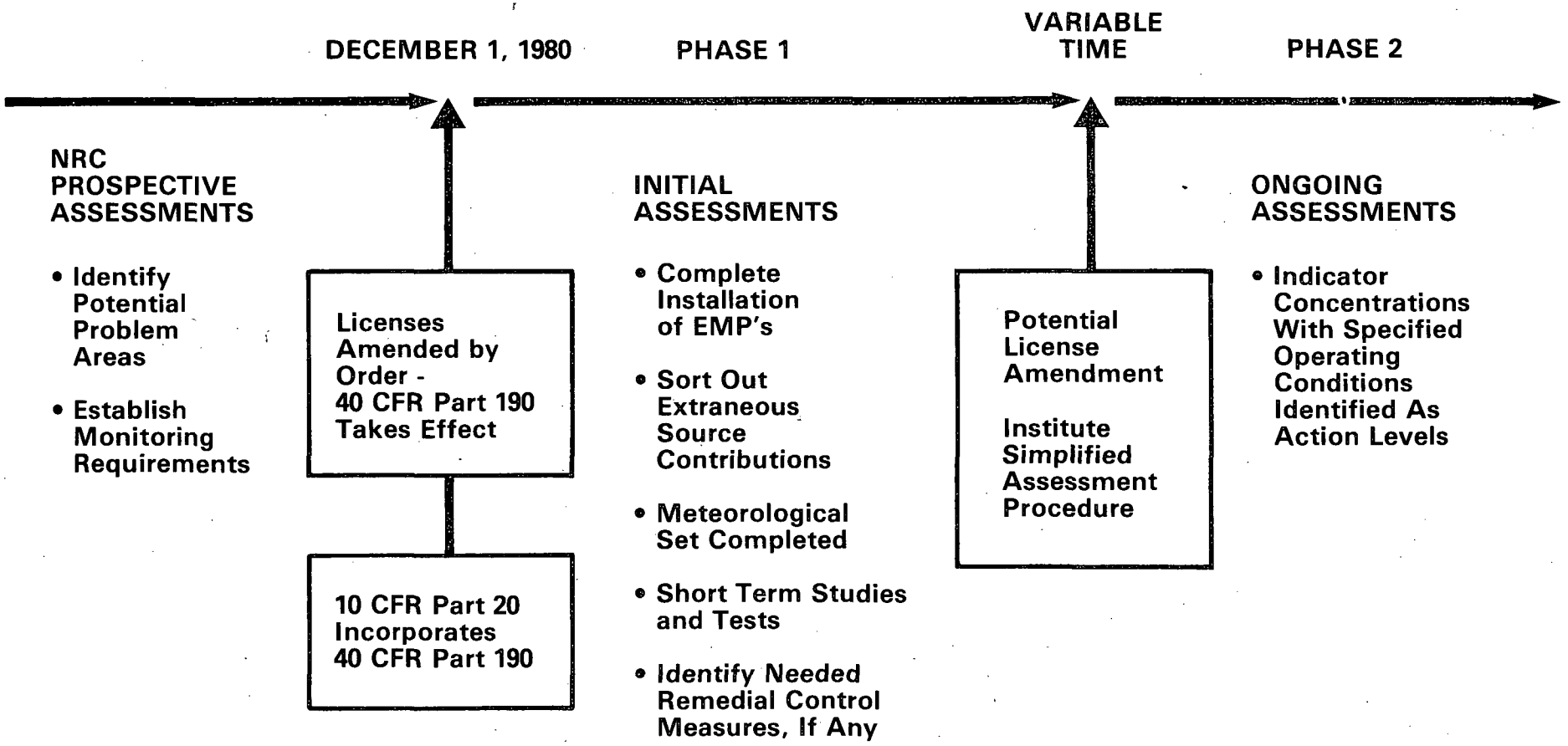
Procedure

The NRC staff will implement 40 CFR Part 190 in a phased fashion as shown in Figure 1. Eventually a standardized procedure which will be used to assess compliance subsequent to the establishment of each licensee's Environmental Monitoring Program (EMP) will be established. It will realistically require effluent and environmental monitoring data collected over a sufficiently long period (usually up to a year) in order to even out short-term variations in releases and meteorology (Phase 1 of Figure 1). Such long-term measurement programs will be of particular importance at mills which are close to the limit or where there are significant nearby sources of radioactive emissions, such as mines, which are not covered by the standard. This time will allow for modifying the monitoring and analysis programs to assure they are operating properly and producing reliable data. Special studies of the effectiveness of selected emission control measures may be necessary. These evaluations may be supplemented by computer assessments in order to relate environmental levels to releases and to calculate collective (population) doses.

Eventually, under Phase 2, it is anticipated that concentration and/or dose action levels (which may even be higher than 25 millirems if necessary to account for contributions from other sources) will be established. This will reduce costs of implementation, eliminate uncertainty on the part of the licensee, regulatory agency, and the public (particularly in cases where there are significant extraneous sources), and assure that the need for remedial action is identified most expeditiously if it exists.

Before environmental monitoring data are available, which will be the situation in licensing of new facilities or in authorizing significant modification to existing ones, predictive models must be utilized to evaluate the potential impacts of the prospective new operations. Predictive modeling assessments of radioactivity concentrations to which nearby individuals may be exposed involve making numerous assumptions and, in some cases, simplifications about

Figure 1
Phased Implementation



important, but frequently uncertain, factors such as mill releases and atmospheric transport. For this reason, as discussed above, actual compliance determination during operation will be based on environmental monitoring data. Predictive models, however, are necessary and valuable tools in evaluating what emission controls are likely necessary, in identifying potential problem areas, and in establishing environmental monitoring programs and locations.

The following describes the procedures which shall be followed in (A) determining compliance with 40 CFR Part 190 based on environmental monitoring data, and (B) assessing proposed operations in terms of their ability to meet 40 CFR Part 190.

A. Assessment of Actual Environmental Monitoring Data

Figure 2 - "40 CFR Part 190 Compliance Determination Procedure" is a diagram of the various steps to assure compliance with 40 CFR Part 190.

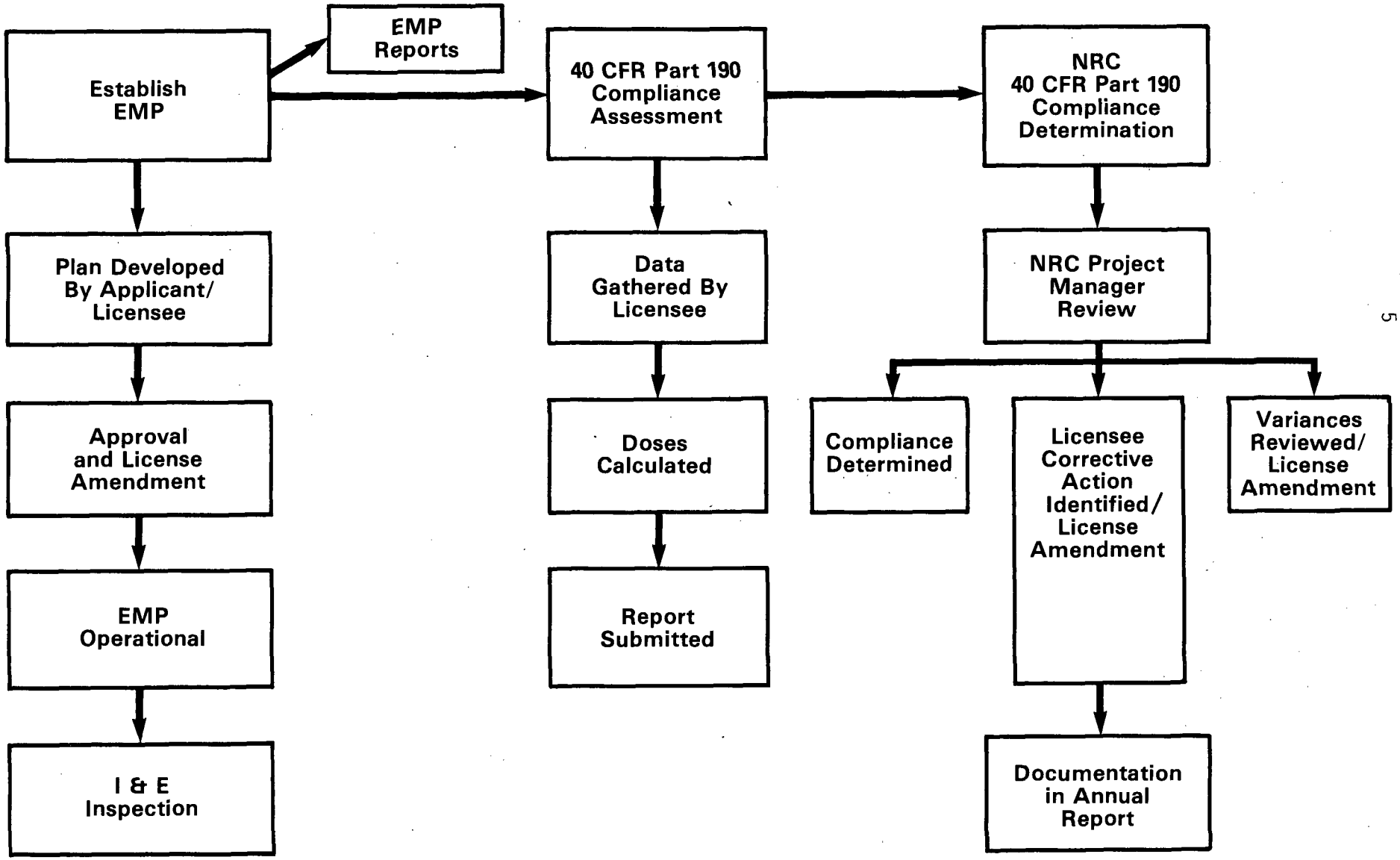
1. An Environmental Monitoring Program (EMP) should be established as required by Criterion 7, Appendix A to 10 CFR Part 40. Such a program should be consistent with NRC's Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills" (April 1980) (Reference 3) which provides specific details for preoperational and operational monitoring programs which are considered adequate by the NRC staff.

   a. Under these requirements it will be necessary for a licensee to develop an EMP and submit a plan to the NRC for review and approval. Acceptable plans would include specific details of the number, location, collection method (i.e., equipment), sampling frequency, and analysis information for all sample types (e.g., air particulate, radon/WL, stack samples, surface and ground waters, vegetation, food, fish, soil, and direct radiation). For each site (including existing mills), at least one year of site-specific meteorological data; e.g., wind speed and direction, stability class, etc., should be collected, summarized, and reported. A site map, including all affected offsite areas, showing each point of sample collection should also be provided. A description of quality assurance procedures including participation in a Quality Assurance Program (QAP) similar to that contained in NRC's Regulatory Guide 4.15, "Quality Assurance Programs for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment" (Reference 4) should also be discussed in the EMP plan.

   b. Upon NRC staff review and approval, the EMP will be added to the license and any subsequent change or modification of the approved EMP would require that a specific license amendment be initiated by the licensee.

   c. The EMP plan should provide a time schedule providing the dates when each phase of the EMP will become operational. For new

Figure 2
40 CFR Part 190
Compliance Determination Procedure
(Based on Actual Environmental Monitoring Data)



license applicants, at least one year of preoperational monitoring shall be required. For existing facilities, a realistic time schedule shall be implemented; however, all phases of the EMP should be operational within 120 days of NRC's approval of the EMP plan.

d. The NRC's Office of Inspection and Enforcement will conduct periodic onsite inspections of both the actual environmental monitoring systems/locations, as well as all reports and records of such an EMP to ensure that the actual operations of the EMP are within the approved EMP license condition.

2. Each licensee shall provide an EMP report every six months, as required in §40.65, "Effluent Monitoring Reporting Requirements of 10 CFR Part 40." The report should contain the specific information as outlined in Section 7 "Recording and Reporting Results" of NRC's Regulatory Guide 4.14 (Reference 3).

3. As a license condition, each licensee will be required to submit, in conjunction with its six-month EMP report (EMPR), its own assessment of compliance with 40 CFR Part 190.*

   a. Such an assessment will normally be based on data gathered by the licensee from the approved EMP as discussed above. Such data gathering should include a semiannual survey of land use (i.e., residences, grazing, water wells, etc.) in the area within 8 km (5 miles) of the mill. Any difference in land use from that previously reported should be discussed and evaluated with respect to 40 CFR Part 190 compliance. In order to minimize records keeping and formal reporting requirements, while still maintaining a reasonable and timely review of the EMP, annual averages based on the immediate past two consecutive six-month reporting periods should be used for the compliance assessment.

   b. Standard procedures and parameters for dose evaluation are contained in Attachment A - "Dose Calculational Guidance." These procedures are based on NRC Regulatory Guide 3.51, "Calculational Models for Estimating Radiation Doses to Man from Airborne Radioactive Materials Resulting from Uranium Milling Operations" (Reference 5). The attached tables are provided to permit dose assessments to be made from environmental monitoring data. Departures from the assumptions made in Attachment A will be allowed if they are supported by actual site data. It is permissible to subtract out the contribution from background and extraneous sources as determined from measured concentrations at background or control locations.

*During the first year following NRC's approval of an acceptable EMP, each licensee shall be required to submit a quarterly EMPR which shows the 40 CFR Part 190 compliance assessment.

c. As necessary, a licensee should indicate in the report what corrective action is being taken to restore compliance when possible instances of noncompliance are indicated from the environment monitoring data. Reports of the results from EMPs shall be submitted to NRC as required by §40.65 of 10 CFR Part 40 within 60 days after January 1 and July 1 of each year thereafter, so long as the license is active.

4. The NRC will review and complete its own independent determination of each licensee's EMPR and 40 CFR Part 190 compliance assessment. Such a review will consider the influence of extraneous sources (e.g., mining and transportation activities) and any anomalous data (e.g., the indication of erroneous data generated during sample collection or sample analysis).

   a. The NRC Project Manager (PM) will review all submittals and be responsible for all approvals, license amendments, and verification of 40 CFR Part 190 compliance.

   i. Upon determination of compliance to 40 CFR Part 190, the PM will document such findings via a brief Memorandum to File (standardized form memo) for the subject license within 30 days of receipt of reports submitted under 3(c).

   ii. Upon determination of noncompliance to 40 CFR Part 190, the PM will assure that the licensee take any necessary corrective actions and will issue specific license amendments as required to accomplish this. This may require differentiating extraneous sources such as background, mining, and transportation activities; obtaining site-specific meteorological data, conducting short-term studies, etc. as shown in Phase 1 of Figure 1 above.

   iii. The PM will review any variance request per 40 CFR 190.11, and will initiate appropriate licensing action as required. The EPA will be notified whenever a variance is granted. A copy of the variance request will also be placed on file in the NRC Public Document Room.

   iv. The PM for 40 CFR Part 190 compliance assessment shall issue a brief annual report summarizing the results of the individual license compliance reviews. This report shall also consider the cumulative dose to any member of the population due to exposure from releases from multiple mill facilities in the general area. The EPA shall be provided with a copy of this summary report for their review and comment.

5. The PM will periodically review and evaluate the EMP, EMP reports, and 40 CFR Part 190 compliance assessments, and will eliminate any requirements that experience shows to be nonessential or shall require specific actions necessary to show compliance. For example, if the airborne concentration measurements show that there is no

need to continue radium-226 or thorium-230 analyses, then such requirements shall be eliminated from the EMP. As shown in Phase 2 of Figure 1, efforts will be made to streamline the periodic compliance assessment effort by prescribing specific concentration levels which, based on experience and in combination with other readily observable parameters related to mill operations and local land use, could be relied upon to determine compliance.

B. Predictive Modeling

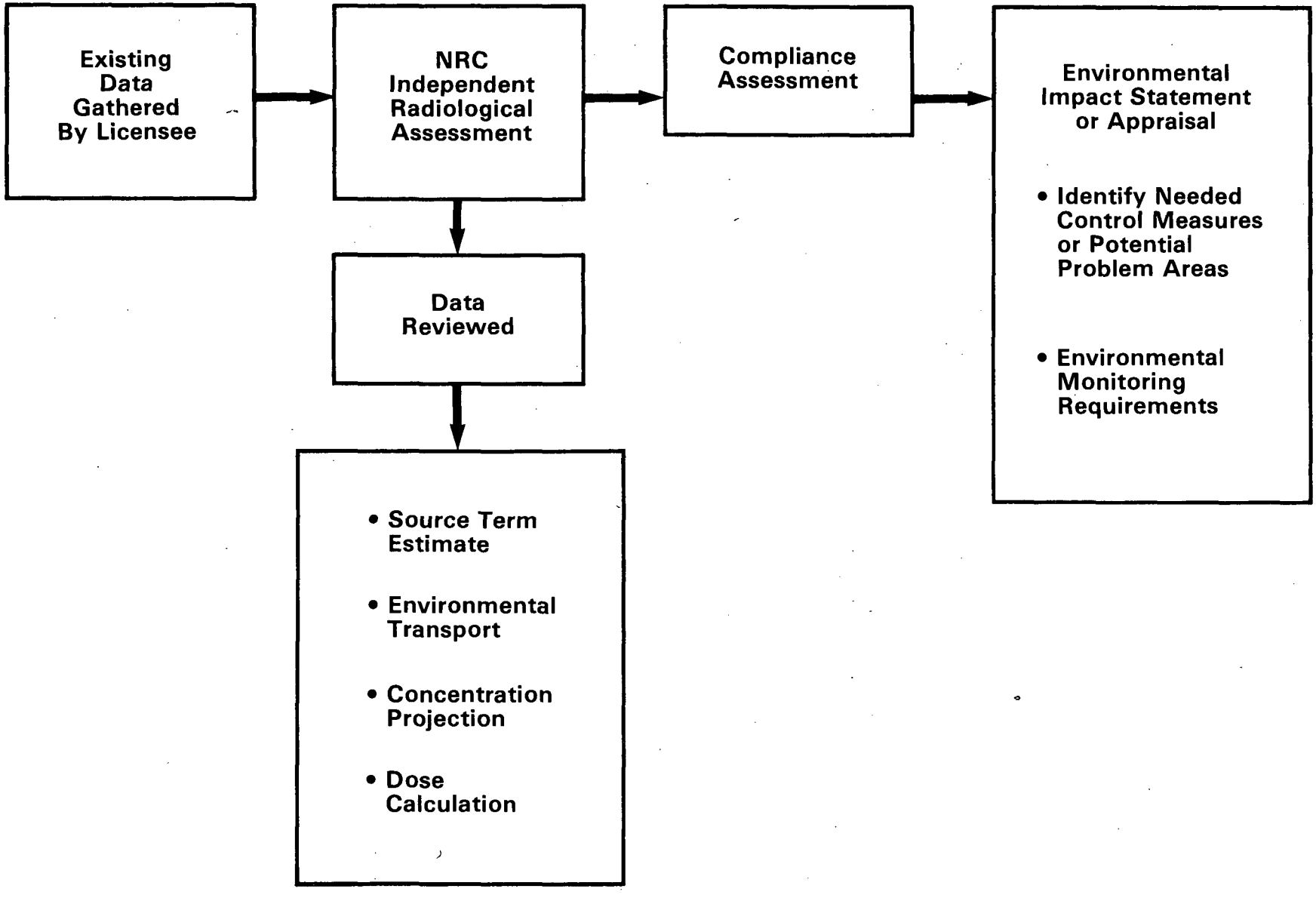
Figure 3 - "NRC Assessment of Prospective Milling Operations" shows a diagram of the various steps which will be followed by the NRC Project Manager in licensing reviews.

1. All existing data, e.g., source term, environmental monitoring data, land use, population distribution, meteorology, etc., will be reviewed by the NRC Project Manager (PM).

2. The NRC PM will complete an independent radiological assessment to 40 CFR Part 190 compliance based on predictive modeling using methodology as described in Regulatory Guide 3.51.

3. These assessments will be documented in the Environmental Impact Statement (EIS) or environmental appraisal conducted in support of the licensing action. These assessments will consider the cumulative dose to any member of the population due to exposure from releases from multiple mill facilities in the general area.

Figure 3
NRC 40 CFR Part 190 Assessment of Prospective Milling Operations (Based on Predictive Modeling)



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APPENDIX A

Attachment A
Dose Calculational Guidance

The estimated dose received by any member of the general population is calculated based on the applicable potential exposure of the nearest resident in the offsite area surrounding the mill site. The total dose is the sum of the external exposure (i.e., due to radiation sources outside the body) and of the internal exposure (i.e., radioactive materials within the body). Doses which are due to preoperational natural background and extraneous sources should be subtracted from those measured at the nearest receptor. The contribution from nonmill sources (e.g., mining and transportation activities) should also be determined based upon actual measurements at representative background locations.

1. External Radiation Exposure -

   The direct radiation exposure may be assumed to be equal to the actual personal or environmental dosimetric data less the appropriate background contribution.

2. Internal Radiation Exposure -

   The total dose to organs (e.g., lung, bone, whole body, etc.) is evaluated based on summing all applicable human pathways, such as:

   a. Inhalation of airborne particulates -

      The measured airborne concentration multiplied by the dose conversion factors as given in Table A-1.

   b. Ingestion of contaminated food and milk -

      The measured concentration in the food product multiplied by the dose conversion factor as given in Table A-2(b) through (d).

   c. Ingestion of meat or milk from livestock grazing on contaminated vegetation -

      The measured concentration in vegetation (e.g., grasses in grazing areas) multiplied by the dose conversion factor as given in Table A-3(a) and (b).

   d. Ingestion of contaminated water -

      The measured concentration in potable water multiplied by the dose conversion factor as given in Table A-4.

e. Ingestion of meat or milk from livestock watered on contaminated water -

The measured concentration in water used by livestock for watering purposes multiplied by the dose conversion factor as given in Table A-5(a) and (b).

If any of the human exposure pathways as given above are not in evidence at a mill site, then that dose contribution does not need to be considered. The total dose for each critical organ shall be obtained by summing the dose due to each radionuclide of the uranium decay chain series (i.e., uranium, radium-226, and thorium-230) and through each pathway, i.e., inhalation plus external exposure plus any applicable ingestion pathways. Since 40 CFR Part 190 excludes the dose due to radon and its daughters, the dose contribution from lead-210 and polonium-210 have been excluded from these assessments of actual environmental monitoring data. However, the dose due to the inhalation pathway is of primary concern, with the other pathways providing supplemental information regarding possible exposure. A thorough evaluation of background conditions must be completed so that any contribution due to the mill operations (i.e., value measured at point of receptor less applicable background level) may be adequately assessed.

Data from the point of receptor should be reviewed in connection with other environmental and effluent monitoring data and other appropriate information or assessment tools (such as computer modeling) in cases where extraneous sources may cause calculated doses to exceed the 40 CFR Part 190 limits or where anomalous data are encountered.

Table A-1 Dose conversion factors for the inhalation of airborne particulates (millirem per pCi/m^3)*

Radionuclide	Whole Body	Bone	Lung
U-238	4.32	79.2	158
U-234	4.92	79.5	180
Th-230	166	5950	3220
Ra-226	30.9	309	6610

*The 50-year dose commitment for each year of exposure to 1 pCi/m^3 of each radionuclide for an adult breathing rate of 20 m^3/day. Particle size of 1.55 μ AMAD (i.e., mean diameter of 1 μm and a density representative of uranium ore. The assumed quality factor for alpha radiations is 10. The total dose per organ is the summation of doses due to each radionuclide (from Table 3 in Regulatory Guide 3.51) (Reference 5).

Table A-2(a) Adult ingestion dose conversion factors

	(mrem per pCi ingested)*			
	Whole Body	Bone	Liver	Kidney
U-238	4.54E-05	7.67E-04	-	1.75E-04
U-234	5.17E-05	8.36E-04	-	1.99E-04
Th-230	5.70E-05	2.06E-03	1.17E-04	5.65E-04
Ra-226**	4.60E-03	4.60E-02	5.74E-06	1.63E-04

*From Table 6 of Regulatory Guide 3.51, Reference 5.

**Adult whole body and bone dose conversion factors for ^{226}Ra have been obtained from Reference 6 and are based on applicable models and data from Reference 7. ^{226}Ra whole body and bone dose conversion factors for other age groups have been computed by assuming the same proportion to adult whole body and bone dose factors as given in Reference 8. All other dose conversion factors are directly from Reference 8.

Table A-2(b) Dose conversion factors for ingestion of contaminated meat* (millirem per $\frac{pCi}{kg}$ in meat)

Radionuclide	Whole Body	Bone	Liver	Kidney
U-238	3.55 E-03	6.01 E-02	0.0	1.37 E-02
U-234	4.05 E-03	6.55 E-02	0.0	1.56 E-02
Th-230	4.46 E-03	1.61 E-01	9.16 E-03	4.42 E-02
Ra-226	3.60 E-01	3.60 E-0	4.49 E-04	1.28 E-02

*The 50-year dose commitment for each year of ingestion of contaminated meat. These values are obtained from the values in Table A-2(a) by multiplying the adult mrem per pCi values by the meat intake which is assumed to be 78.3 kilograms per year (beef, poultry, pork, mutton).

Table A-2(c) Dose conversion factors for ingestion of contaminated edible vegetation* (millirem per $\frac{pCi}{kg}$ in vegetation)

Radionuclide	Whole Body	Bone	Liver	Kidney
U-238	2.38 E-03	4.03 E-02	0.0	9.19 E-03
U-234	2.71 E-03	4.39 E-02	0.0	1.04 E-02
Th-230	2.99 E-03	1.08 E-01	6.14 E-03	2.97 E-02
Ra-226	2.42 E-01	2.42 E+00	3.01 E-04	8.56 E-03

*The 50-year dose commitment for each year of ingestion of contaminated edible vegetation.

A factor of 50% activity reduction through food preparation was assumed, and an adult ingestion rate of 105 kg/yr total vegetable ingestion rate, as well as uniform concentration throughout all vegetable types. Should data be presented as the radionuclide concentration in edible aboveground vegetables, C_1; potatoes, C_2; and other below ground vegetables, C_3; then the following weighted concentration C_v should be used when multiplying the above dose factors:

$$C_v = 0.38\ C_1 + 0.58\ C_2 + 0.05\ C_3$$

Table 5 of Regulatory Guide 3.51 contains detailed information on the assumed vegetable consumption rates C_1, C_2, and C_3. The dose factors in the above table are based upon multiplying the adult mrem per pCi values in Table A-2(a) the assumed vegetable intake rate of 105 kg/yr, and an assumed 0.5 retention factor for residual activity after food processing.

Table A-2(d) Dose conversion factors for ingestion of contaminated milk* (millirem per pCi/L in milk)

Radionuclide	Whole Body	Bone	Liver	Kidney
U-238	5.90 E-03	9.97 E-02	0.0	2.28 E-02
U-234	6.72 E-03	1.09 E-01	0.0	2.59 E-02
Th-230	7.41 E-03	2.68 E-01	1.52 E-02	7.35 E-02
Ra-226	5.98 E-01	5.98 E+00	7.46 E-04	2.12 E-02

*The 50-year dose commitment for each year of ingestion of contaminated milk. Since children drink greater quantities, the resultant dose is much higher for younger people. Dose conversion factors are for adults and are based upon multiplying the adult mrem per pCi values from Table A-2(a) by a milk consumption rate of 130 liters/year.

Table A-3(a) Dose conversion factors for ingestion of meat from cattle grazing on contaminated vegetation* (millirem per pCi/kg in vegetation)

Radionuclide	Whole Body	Bone	Liver	Kidney
U-238 U-mat	6.04 E-05 6.46E-05	1.02 E-03 1.07 E-03	0.0	2.33 E-04 2.49 E-04
U-234	6.88 E-05	1.11 E-03	0.0	2.65 E-04
Th-230	4.46 E-05	1.61 E-03	9.16 E-05	4.42 E-04
Ra-226	9.18 E-03	9.18 E-02	1.15 E-05	3.25 E-04

*The 50-year dose commitment for each year of ingestion of meat. The above values are based on the following:

i) Animal uptake of vegetation: 50 kg/day

ii) Environmental transfer coefficients: $\frac{\text{pCi/kg}}{\text{pCi/day}}$

U - 3.4×10^{-4}
Th - 2.0×10^{-4}
Ra - 5.1×10^{-4}

iii) Adult meat ingestion rate: 78.3 kg/year

iv) Adult ingestion dose conversion factors (from Table A-2(a))

Table A-3(b) Dose conversion factors for human consumption of milk from dairy cows ingesting contaminated vegetation

(Millirem per $\frac{pCi}{kg}$ in vegetation)

Radionuclide	Whole Body	Bone	Liver	Kidney
U-238	1.80 E-04	3.03 E-03	0.0	6.94 E-04
U-234	2.05 E-04	3.31 E-03	0.0	7.89 E-04
Th-230	1.85 E-06	6.70 E-05	3.80 E-06	1.84 E-05
Ra-226	1.76 E-02	1.76 E-01	2.20 E-05	6.25 E-04

* The 50-year dose commitment for each year of ingestion of milk. The above values are based on the following:

i) Animal uptake of vegetation: 50 kg/day

ii) Environmental transfer coefficients: ($\frac{pCi/kg}{pCi/day}$)

U - 6.1×10^{-4}
Th - 5.0×10^{-6}
Ra - 5.9×10^{-4}

iii) Adult consumption of milk: 130 liters/year

iv) Adult ingestion dose conversion factors (from Table A-2(a)

Table A-4 Dose conversion factors for human consumption of contaminated water (millirem per $\frac{pCi}{L}$ in water)*

Radionuclide	Whole Body	Bone	Liver	Kidney
U-238	1.68 E-02	2.84 E-01	0.0	6.48 E-02
U-234	1.91 E-02	3.09 E-01	0.0	7.36 E-02
Th-230	2.11 E-02	7.62 E-01	4.33 E-02	2.09 E-01
Ra-226	1.70 E+00	1.70 E+01	2.12 E-03	6.03 E-02

*The 50-year dose commitment for each year of ingestion of contaminated water. The above values are based on an average adult consumption rate of 370 liters/year from Regulatory Guide 1.109 (Reference 9) and adult ingestion dose conversion factors from Table A-2(a).

Table A-5(a) Dose conversion factors for ingestion of meat from cattle watered on contaminated water (millirem per $\frac{pCi}{L}$ of animal drinking water)*

Radionuclide	Whole Body	Bone	Liver	Kidney
U-238	6.04 E-05	1.02 E-03	0.0	2.33 E-04
U-234	6.88 E-05	1.11 E-03	0.0	2.65 E-04
Th-230	4.46 E-05	1.61 E-03	9.16 E-05	4.42 E-04
Ra-226	9.18 E-03	9.18 E-02	1.15 E-05	3.25 E-04

*The 50-year dose commitment for each year of ingestion of meat. The above values are based on the following:

i) Animal uptake of water: 50 liters/day

ii) Environmental transfer coefficients: $\frac{pCi/kg}{pCi/day}$

U - 3.4×10^{-4}

Th - 2.0×10^{-4}

Ra - 5.1×10^{-4}

iii) Adult meat ingestion rate of 78.3 kg/year

iv) Adult ingestion dose conversion factors from Table A-2(a).

Table A-5(b) Dose conversion factors for human consumption of milk from dairy cows watered on contaminated water (millirem per $\frac{pCi}{L}$ in animal drinking water)*

Radionuclide	Whole Body	Bone	Liver	Kidney
U-238	2.16 E-04	3.65 E-03	0.0	8.33 E-04
U-234	2.46 E-04	3.98 E-03	0.0	9.47 E-04
Th-230	2.22 E-06	8.03 E-05	4.56 E-06	2.20 E-05
Ra-226	2.12 E-02	2.12 E-01	2.64 E-05	7.50 E-04

*The 50-year dose commitment for each year of ingestion of milk. The above values are based on the following:

i) Dairy animal water intake rate: 60 liters/day

ii) Adult milk ingestion rate: 130 liters/day

iii) Environmental transfer coefficients: $\frac{pCi/liter}{pCi/day}$

U - 6.1×10^{-4}

Th - 5.0×10^{-6}

Ra - 5.9×10^{-4}

iv) Adult ingestion dose conversion factors from Table A-2(a).

APPENDIX B

Monitoring Requirements from Appendix A to 10 CFR Part 40 from Federal Register Vol. 45, No. 197, Friday, October 3, 1980 (45 FR 65535)

Criterion 8 - Milling operations shall be conducted so that all airborne effluent releases are reduced to levels as low as is reasonably achievable. The primary means of accomplishing this shall be by means of emission controls. Institutional controls, such as extending the site boundary and exclusion area, may be employed to ensure that offsite exposure limits are met, but only after all practicable measures have been taken to control emissions at the source. Notwithstanding the existence of individual dose standards, strict control of emissions is necessary to assure that population exposures are reduced to the maximum extent reasonably achievable and to avoid site contamination. The greatest potential sources of offsite radiation exposure (aside from radon exposure) are dusting from dry surfaces of the tailings disposal area not covered by tailings solution and emissions from yellowcake drying and packaging operations.

Checks shall be made and logged hourly of all parameters (e.g., differential pressures and scrubber water flow rates) which determine the efficiency of yellowcake stack emission control equipment operation. It shall be determined whether or not conditions are within a range prescribed to ensure that the equipment is operating consistently near peak efficiency; corrective action shall be taken when performance is outside of prescribed ranges. Effluent control devices shall be operative at all times during drying and packaging operations and whenever air is exhausting from the yellowcake stack. Drying and packaging operations shall terminate when controls are inoperative. When checks indicate the equipment is not operating within the range prescribed for peak efficiency, actions shall be taken to restore parameters to the prescribed range. When this cannot be done without shutdown and repairs, drying and packaging operations shall cease as soon as practicable. Operations may not be restarted after cessation due to off-normal performance until needed corrective actions have been identified and implemented. All such cessations, corrective actions, and restarts shall be reported to the appropriate NRC regional office as indicated in Criterion 8A, in writing, within 10 days of the subsequent restart.

To control dusting from tailings, that portion not covered by standing liquids shall be wetted or chemically stabilized to prevent or minimize blowing and dusting to the maximum extent reasonably achievable. This requirement may be relaxed if tailings are effectively sheltered from wind, such as may be the case where they are disposed of below grade and the tailings surface is not exposed to wind. Consideration shall be given in planning tailings disposal programs to methods which would allow phased covering and reclamation of tailings impoundments since this will help in controlling particulate and radon emissions during operation. To control dusting from diffuse sources, such as tailings and ore pads where automatic controls do not apply, operators shall develop written operating procedures specifying the methods of control which will be utilized.

Criterion 8A - Daily inspections of tailings or waste retention systems shall be conducted by a qualified engineer or scientist and documented. The appropriate NRC regional office as indicated in Appendix D of 10 CFR Part 20, or the Director, Office of Inspection and Enforcement, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, shall be immediately notified of any failure in a tailings or waste retention system which results in a release of tailings or waste into unrestricted areas, and/or of any unusual conditions (conditions not contemplated in the design of the retention system) which if not corrected could indicate the potential or lead to failure of the system and result in a release of tailings or waste into unrestricted areas.

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Uranium Milling operations are licensed by the Nuclear Regulatory Commission and by some States in agreement with the Commission. The radiation dose to any individual from the operation of facilities within the uranium fuel cycle is limited to levels set by the Environmental Protection Agency. These levels are contained in the EPA Environmental Radiation Protection Standards for Nuclear Power Operations, in Part 190 of Title 40 of the Code of Federal Regulations (40 CFR Part 190). This report describes the procedures used within NRC's Uranium Recovery Licensing Branch for evaluating compliance with these regulations for uranium milling operations. The report contains descriptions of these procedures, dose factors for evaluating environmental measurement data, and guidance to the NRC staff reviewer.

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