

STATE OF MICHIGAN  
DEPARTMENT OF NATURAL RESOURCES  
SUPERVISOR OF WELLS  
SUPERVISOR OF MINERAL WELLS

IN THE MATTER OF:

THE NEED AND DESIRABILITY )  
TO ISSUE AN ORDER ESTABLISHING )  
PARTICULAR REQUIREMENTS FOR ) ORDER NO. 3-6-92  
PLUGGING OF WELLS WHERE ) ORDER NO.(M) 1-6-92  
NATURALLY OCCURRING RADIOACTIVE) )  
MATERIAL (NORM) MAY BE PRESENT ) )

**OPINION AND ORDER OF THE SUPERVISOR OF WELLS**  
**AND SUPERVISOR OF MINERAL WELLS**

On June 16 and 17, 1992, a technical evidentiary hearing was held before the Supervisor of Wells, the oil and Gas Advisory Board, the Supervisor of Mineral Wells, and the Mineral Well Advisory Board. The hearing was conducted pursuant to 1939 PA 61, as amended, the promulgated rules and 1969 PA 315, as amended.

The purpose of the hearing was to receive evidence and testimony pertaining to the need and desirability of establishing requirements for the plugging of wells drilled under the authority of 1939 PA 61, as amended, and 1969 PA 315, as amended, in which Naturally Occurring Radioactive Material (NORM) may be present.

**FINDINGS OF FACT**

1. NORM is the acronym for "naturally occurring radioactive material." NORM is found virtually everywhere in nature. NORM is found in small quantities in the ground, in the food we eat, in the air we breathe, in the elements that compose our bodies and in man-made structures composed of natural materials such as bricks and wallboard. We are all exposed to natural radiation sources which contribute to our annual radiation doses to various degrees.

2. Until recently the existence of NORM associated with the production of hydrocarbons in Michigan was unknown. In 1989 Louisiana notified other states of the potential for NORM associated with the production of hydrocarbons. NORM occurs as a result of scale deposition on well casing and down hole equipment. Raymond Vugrinovich, Michigan Geological Survey Division (GSD) geologist, testified the GSD and Michigan Department of Public Health (DPH) investigated the occurrence of

NORM associated with oil and gas operations. Hand-held gamma scintillometer surveys were conducted at approximately 270 oil and gas production sites and revealed elevated gamma radiation levels at about 20% of the sites. They determined the NORM levels detected were not an immediate threat to public health and safety. Based on the surveys, the Supervisor proposed consideration of a special order for the following counties:

Alcona, Allegan, Alpena, Antrim, Arenac, Barry, Bay, Benzie, Berrien, Branch, Calhoun, Cass, Charlevoix, Cheboygan, Clare, Clinton, Crawford, Eaton, Emmet, Genesee, Gladwin, Grand Traverse, Gratiot, Hillsdale, Huron, Ingham, Ionia, Iosco, Isabella, Jackson, Kalamazoo, Kalkaska, Kent, Lake, Lapeer, Leelanau, Lenawee, Livingston, Macomb, Manistee, Mason, Mecosta, Midland, Missaukee, Monroe, Montcalm, Montmorency, Muskegon, Newaygo, Oakland, Oceana, Ogemaw, Osceola, Oscoda, Otsego, Ottawa, Presque Isle, Roscommon, Saginaw, St. Clair, St. Joseph, Sanilac, Shiawassee, Tuscola, Van Buren, Washtenaw, Wayne and Wexford.

3. Full Parties to the hearing included the Department of Natural Resources-Geological Survey Division (GSD), Shell Western Exploration and Production, Incorporated (SWEPI), Amoco Production Company (AMOCO), Michigan Oil and Gas Association (MOGA) and the Michigan Public Service Commission (MPSC).

4. Several persons who did not elect to become full Parties made statements concerning the law and policy to be applied in this matter. A range of opinion was offered. One oil and gas operator expressed the opinion that NORM posed no health or environmental risk and no regulation was required or necessary. Others expressed the opinion that any source of radioactive material, regardless of its intensity, posed significant risk to health and the environment.

5. Raymond Vugrinovich, GSD staff, testified that NORM scale found in oil, gas and mineral wells in Michigan is formed over time and is found only on mature producing wells that are near or ready to be plugged. This conclusion was supported by Clay Harrelson, a SWEPI senior production engineer, who testified that NORM is most likely to appear as scale on the outside of casing exposed to the interval from the top of the Antrim Formation to the Dundee Formation.

6. SWEPI presented three internationally recognized experts who testified about radioactivity and its affects on people and nature. SWEPI's first witness, John Auxier, PhD, is an expert in nuclear engineering and health physics. During his

tenure at the Oakridge National Laboratory, where he was Director of the Health Physics Division, Dr. Auxier directed research in the investigation of pathways of exposure and biological affects of nuclear pollutants and radiation safety. Dr. Auxier testified as to his examination of pipe scale that was found to have NORM. He described the scale as being radium sulfate incorporated within a barium sulfate matrix. He testified this material is extremely insoluble and, therefore, difficult for plants and humans to retain. He concluded that workers in repeated contact with well casing measuring 50 micro R/hr. would experience no health problems. Notwithstanding Dr. Auxier's opinion that casing found to have NORM would pose no health risk, he testified he understood the instinctive public concern over anything "radioactive." Dr. Auxier testified that an action level of 50 micro R/hr. would be easy to measure in the field and would be far more restrictive than is necessary to protect health. Therefore, he concluded it made sense to return casing found to have NORM down the well bore.

7. SWEPI's second witness, Dr. Eugene Saenger, M.D., is Professor Emeritus of Radiology at the University of Cincinnati College of Medicine. He is an expert on radiation, radiation biology and radiation epidemiology. He testified that relatively small amounts of insoluble, radioactive scale do not pose a significant health risk. Dr. Saenger, in his work, has not observed harm to humans from any chronic exposure below 100 rem (100 million microrem) per year. He testified contact with NORM scale is not a significant health risk and that any NORM scale dust which was inhaled would be expelled by the body without consequence. He found a 50 micro R/hr. contact reading, as proposed by SWEPI as an action level, would pose absolutely no biological hazard to the worker or general public. In his opinion returning NORM to the bore hole is desirable from a point of general radiation hygiene.

8. SWEPI's third witness, Robert Rowland, PhD, is the former associate director for Biomedical and Environmental Research at the Argonne National Laboratory. He is an expert in mineral metabolism and the affects of internally deposited radioisotopes on humans. He studied workers who had cleaned NORM scale from well casings. He concluded that NORM found on well casings does not pose a health risk. His study found that pipeworkers, regularly exposed to NORM, had no more radium in their bodies than would be expected in a member of the general public. He testified the NORM scale is water insoluble and of relatively large particle size. Thus, it is not readily taken up by plants and, if inhaled or ingested by humans, it will simply pass out of the body. Dr. Rowland has done extensive studies of the radium exposure of radium dial painters. In Dr. Rowland's

opinion, a person could not ingest enough NORM to approach the body radiation counts demonstrated by his studies of radium dial painters. He testified the suggested 50 micro R/hr. action level is more than low enough to assure no harm to humans or the environment. Dr. Rowland testified leaving NORM casing in the well bore was a superb method of disposing of the pipe, insuring that the insoluble NORM stayed in the strata from which it came.

9. Based upon the testimony presented by these experts and the general consensus of the Parties I find, as a Matter of Fact, it is important to develop a safe and reasonable protocol for addressing oil, gas and mineral well operations when NORM scale is present.

10. Four proposals for plugging wells found to have NORM were offered by the Parties. There is general agreement among the proposals that casing containing NORM scale should be left in or reinserted into well bores. Based upon the evidence presented, I find, as a Matter of Fact, casing found to have NORM is best left in or reinserted into the well bore from which it came.

11. The proposals also agree that a 50 micro R/hr. action level is easy to measure in the field and is stringent enough to protect workers and the public. The GSD did not propose an action level for casing containing NORM scale. I find, as a Matter of Fact, when NORM scale is detected an action level of 50 micro R/hr. is sufficient to protect workers and the public.

12. There is disagreement among the Parties as to the proper plugging of a well containing NORM scale. Mr. Vugrinovich testified there is concern water in the NORM producing strata will migrate and commingle with strata containing fresh water if a proper plugging procedure is not required. Edward Everett, a hydrogeologist who has expertise in groundwater hydrology and with the hydrology of the northern Michigan reef trend, testified for SWEPI. He testified waters from NORM producing strata do not normally migrate and commingle with the strata containing fresh water. He testified fresh water may flow downward but that, in northern Michigan, brine will not flow upward. Mr. Everett concluded, based upon these facts, there was no chance of NORM contamination of freshwater from wells plugged as recommended by SWEPI. He also testified that the insolubility of NORM scale and its particulate form eliminated any real chance for migration in a well plugged under the SWEPI proposal. In his opinion a 10-foot cement cap is more than sufficient to insure NORM abandoned in the well bore will never move.

13. The Parties offered differing opinions as to the proper thickness of the uppermost cement plug to be installed in wells containing NORM. AMOCO asserted that a NORM well should be plugged in the same manner as any other well. It reasons the existing plugging method provides adequate protection against any potential migration of NORM materials. GSD recommended a 500-foot cement plug above any NORM materials is appropriate; MOGA and SWEPI suggest that a 50-foot cement plug is more than adequate to isolate casing with NORM scale. Clay Harrelson, a senior production engineer for SWEPI, testified about SWEPI's plugging procedure for Niagaran wells, the GSD/SWEPI experimental plugging of the Whitewater 3-38 Well containing NORM scale, and SWEPI's proposal for plugging wells containing NORM scale. I find, as a Matter of Fact, a 50-foot cement plug will adequately prevent surface or underground waste from NORM materials.

#### CONCLUSIONS OF LAW

1. Section 2(1) of 1939 PA 61, as amended, defines "waste" in addition to its ordinary meaning to include:

(1) "Underground waste" as those words are generally understood in the oil business, and in any event to embrace . . . (2) unreasonable damage to underground fresh or mineral waters, natural brines, or other mineral deposits from operations for the discovery, development, and production and handling of oil or gas.

(2) "Surface waste," as those words are generally understood in the oil business, and in any event to embrace (1) the unnecessary or excessive surface loss or destruction without beneficial use . . . (2) the unnecessary damage to or destruction of the surface, soils, animal, fish or aquatic life or property, or other environmental values from or by oil and gas operations; . . .

2. Section 5 of 1939 PA 61, as amended, provides in part:

The supervisor shall have, and he is hereby given (a) jurisdiction and authority over the administration and enforcement of the provisions of this act and all matters relating to the prevention of waste as defined herein . . .; and (b) jurisdiction and control of and over all persons and things necessary or proper to enforce effectively the provisions of this act and all matters relating to the prevention of waste and the conservation of oil and gas.

3. Section 2 of 1969 PA 315, as amended, defines waste as:

(s) "Underground waste" means damage or injury to potable water, mineralized water, or other subsurface resources.

(t) "Surface waste" means damage to, injury to, or destruction of surface waters, soils, animal, fish and aquatic life or surface property from unnecessary seepage or loss incidental to or resulting from drilling, equipping, or operating a well or wells subject to this act.

4. Section 3 of 1969 PA 315, as amended, provides:

A person shall not cause surface or underground waste in the drilling, development, production, operation or plugging of wells subject to this act.

5. I conclude, as a Matter of Law, the improper handling of NORM could result in waste by the unnecessary damage to groundwater and the surface environment.

#### DETERMINATION AND ORDER

Based upon the evidence and after consulting with and considering the recommendations of the Advisory Boards, the Supervisor finds that a special order for handling casing found to have NORM is necessary and desirable.

#### **Now, therefore, it is ordered:**

1. This Order is not intended to supersede any applicable federal or state laws or regulations or authorities pertaining to the possession, handling, storing, transporting, using or recycling of radioactive material.

2. For the purposes of this order, "material" means well casings, tubulars and down hole equipment from the well bore and miscellaneous substances, soils or equipment generated on site during the plugging operation of the well.

3. For the purpose of this Order, material shall be considered "NORM material" when the gamma radiation level, minus the average natural background, equals or exceeds 50 microRoentgens per hour. The radiation level shall be determined by using down hole or surface instruments for measurement

immediately prior to plugging the well or during the well plugging operation. The testing protocol and instruments to be used shall be as approved by the Supervisor.

4. If NORM material exists or it is not known at the start of plugging operations whether NORM material exists, the well permittee has the following options:

Option A. Remove all free tubulars and store, reuse or recycle all or part of the NORM material pursuant to applicable federal and state laws and regulations and plug the well pursuant to normal plugging instructions issued by the supervisor; or

Option B. Remove all free tubulars from the well bore until NORM tubulars reach the surface. Reinsert NORM materials along with tubulars still in the hole and abandon reinserted material in accordance with Sections 5A through 5F and 6 of this order; or,

Option C. Remove all free tubulars and down hole equipment from the well bore and reinsert and abandon part or all of the NORM material in the same well bore from which it was taken or generated as part of the plugging operation in accordance with sections 5B through 5F that follows in this Order.

5. The following conditions apply to wells plugged pursuant to section 4 above:

A. All tubular material reinserted in the well bore pursuant to Option B shall be encased in cement throughout its exterior and interior length.

B. All reinserted material must be between plugs or encased in cement and be placed as deep in the well as possible.

C. NORM material which is reinserted or must be left in the well bore due to well bore problems must be at least 100 feet below the surface casing shoe or 100 feet below the lowest known or suspected fresh water bearing aquifer, if that aquifer is below the base of the surface casing shoe.

D. Before any material is reinserted, any cement plug upon which it will rest must be allowed to set for at least 12 hours and must be tagged with at least 5000 pounds of weight to ensure it is properly located and set.

- E. A cement plug of at least 50 feet in thickness and formulated to resist sulfate solutions must be placed immediately above the highest point at which the reinserted NORM material is placed. The top of the plug must be confirmed by tagging with a 5000 pound weight or the plug of cement must be supported by a mechanical bridge plug that was tested by 5000 pounds of weight.
- F. All open hole plugs presently required by the supervisor pursuant to normal plugging instructions must be set.
- G. A detailed description of the plugging operation including a written inventory of all non-NORM and NORM material reinserted and the depths at which it was placed shall be filed with the plugging record along with a signed certified statement by an independent consultant experienced in plugging operations or by the permittee that all required conditions were met.

6. If special well conditions exist which prevents meeting the requirements of Options B or C, the permittee shall submit a detailed well plugging plan to the Supervisor for approval which demonstrates that the protective conditions prescribed are met or exceeded. Under no circumstances shall NORM material be abandoned in a well bore at a depth less than 100 feet below the surface shoe or 100 feet below lowest known or suspected fresh water aquifer, if that aquifer is below the surface casing shoe.

7. The Supervisors Notice dated June 6, 1991 is rescinded. Tubulars or other down hole equipment that are not NORM materials may be used for construction of other wells.

- 8. This Order shall be of immediate effect.

Dated: November 3, 1992

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R. THOMAS SEGALL  
ASSISTANT SUPERVISOR OF WELLS  
SUPERVISOR OF MINERAL WELLS