American Nuclear Society

REAFFIRMED
October 3, 1989
ANSI/ANS-2.9-1980
(R1989)

evaluation of ground water supply for nuclear power sites

an American National Standard

WITHDRAWN
July 28, 2000
ANSI/ANS-2.9-1980
(R1989)

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published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60525 USA

ANSI/ANS-2.9-1980

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American National Standard for Evaluation of Ground Water Supply for Nuclear Power Sites

Secretariat
American Nuclear Society

Prepared by the
American Nuclear Society
Standards Committee
Working Group ANS-2.9

Published by the
American Nuclear Society
555 North Kensington Avenue
La Grange Park, Illinois 60525 USA

Approved April 9, 1980
by the
American National Standards Institute, Inc.

American National Standard

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Published by

American Nuclear Society
555 North Kensington Avenue, La Grange Park, Illinois 60525 USA

Price: $24.00

Printed in the United States of America

Foreword

(This Foreword is not a part of American National Standard for Evaluation of Ground Water Supply for Nuclear Power Sites, ANSI/ANS-2.9-1980.)

The purpose of this document is to specify standards for evaluating the availability of ground water for safety and non-safety related supplies at power reactor sites. This standard was prepared by Working Group ANS-2.9 of ANS-2 Subcommittee, Site Evaluation, of the American Nuclear Standards Committee.

The initial meeting of the working group was held in October, 1974. At that meeting, the working group was designated as ANS-2.9, Standards for Evaluating Water Supply and Waterborne Radionuclide Transport for Nuclear Power Sites. This working group was subdivided into surface water and ground water sub-groups, and, the working group was formally subdivided at the March, 1975 meeting of the ANS-2 subcommittee into ANS-2.9, Standards for Evaluating Water Supply and Waterborne Radionuclide Transport for Power Reactor Sites: Ground Water, and ANS-2.13, Standards for Evaluating Water Supply and Waterborne Radionuclide Transport for Power Reactor Sites: Surface Water.

The draft standard, ANS-2.9, was balloted on May 31, 1977, by the ANS-2 Subcommittee with 12 approved, 10 approved with comments, 2 disapproved, 1 not voting, and 2 unreturned ballots. As a result of comments received during this balloting, the draft standard was further sub-divided into ANS-2.9, American National Standard for Evaluation of Ground Water Supply for Nuclear Power Sites, and ANS-2.17, American National Standard for Evaluation of Radionuclide Transport in Ground Water for Nuclear Power Sites. These draft standards, dated January, 1978, were transmitted to the ANS-2 Subcommittee in June, 1978, for information and informal comments. The draft standards were revised to incorporate these informal comments. As a result of these revisions, the two disapproved ballots were changed to approved with comments.

This standard covers parts of the material that meet the requirements of Section 2.4, Hydrologic Engineering, of the Standard Format and Content of Safety Analysis Report for Nuclear Power Plants, Regulatory Guide 1.70, issued by the Nuclear Regulatory Commission (NRC).

Before preparing the Safety Analysis Report (SAR) Section 2.4, for the licensing of nuclear power plants, the applicant should be aware of hydrologic work which has been done by others in the area of interest. Almost invariably, much work can be saved by utilizing all or parts of studies by local, state, and federal agencies. Such information as historical ground water levels, pumping tests, well logs, withdrawal and recharge rates, geologic data, hydraulic parameters of underlying formations, location and extent of aquifers, and water quality can be obtained from such sources.

Federal agencies which have useful data are the U.S. Geological Survey, Corps of Engineers, Bureau of Reclamation, Soil Conservation Service, Forest Service, Tennessee Valley Authority, Environmental Protection Agency, and the Nuclear Regulatory Commission. Most states have one or more agencies which are concerned with various aspects of water resources. Various local and interstate agencies, including soil and water conservation districts, irrigation districts, and river basin commissions, can be sources of information. SAR's for other nuclear facilities in the region can provide data.

It is also profitable to discuss the specific site in detail with the hydrology staff of the NRC prior to starting preparation of Section 2.4. In such discussions the scope of work can often be reduced and methodologies and procedures can be agreed upon, which will save many man-hours and dollars, both for the applicants and for the NRC staff.

Working Group ANS-2.9 of the Standards Committee of the American Nuclear Society had the following membership:

David L. Siefken, Chairman, *Sargent & Lundy*
Y. C. Chang, *Stone & Webster Engineering Company*
Stanley N. Davis, *University of Arizona*
James O. Duguid, *Battelle Memorial Institute*
I. Wendell Marine, *E. I. DuPont de Nemours & Company*
John A. McLaughlin, *Pacific Gas and Electric Company*
William M. McMaster, *Tennessee Valley Authority*
Thomas Nicholson, *U.S. Nuclear Regulatory Commission*

The chairman of the working group prior to preparation of Draft 4, dated December 1978, was Patrick J. Ryan, Bechtel, Inc. Prior to his retirement, Donald L. Milliken represented the U.S. Nuclear Regulatory Commission.

Subcommittee ANS-2, Site Evaluation, of the American Nuclear Society Standards Committee had the following members at the time of its approval of this standard:

R. V. Bettinger, Chairman, *Pacific Gas and Electric Company*
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J. A. Fischer, *Dames & Moore*
Walter W. Hays, *U.S. Geological Survey*
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Earl Ivan White, *General Atomic Company*
Karl Wiedner, *Bechtel Power Corporation*

The members of American Nuclear Society's Nuclear Power Plant Standards Committee (NUPPSCO) at the time it balloted this standard in July 1979 were:

J. F. Mallay, Chairman
M. D. Weber, Secretary

Name of Representative	*Organizations*
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G. L. Wessman	*General Atomic Company*
J. E. Windhorst	*Southern Company Services (for the American Society of Mechanical Engineers)*
E. R. Wiot	*NUS Corporation*

Contents

Evaluation of Ground Water Supply for Nuclear Power Sites

1. Scope and Purpose

This standard presents guidelines for the determination of the availability of ground water supplies for nuclear power plant operations with respect to both safety and non-safety related aspects.

1.1 Coverage. This standard covers that material necessary to determine the availability and adequacy of safety and non-safety related ground water supplies for nuclear power plants. This standard contains mandatory requirements except as specifically excluded for non-safety related ground water uses and supply systems.

1.2 Exclusions. This standard does not include the effect of ground water on the design or construction of plant foundations. This standard does not include any environmental effects of the nuclear power plant on the ground water system, except as they affect ground water as a supply source.

2. Definitions

In general, ground water terms are used in accordance with definitions as described by Lohman and others.[1][1] Definitions are given below for terms which can have more than one meaning to ground water hydrologists.

anisotropic. The properties at any point within a medium are different in different directions.

drawdown (L). The lowering of the water level caused by withdrawal of water, with reference to some datum and to the time since withdrawal began.

heterogeneity. The properties or conditions of isotropy or anisotropy vary from point to point in the medium.

homogeneity. The properties or conditions of isotropy or anisotropy are constant from point to point in the medium.

hydraulic conductivity (LTw^{1}). "A medium has a hydraulic conductivity of unit length per unit time if it will transmit in unit time a unit volume of ground water at the prevailing viscosity through a cross section of unit area, measured at right angles to the direction of flow, under a hydraulic gradient of unit change in head through unit length of flow."[2] The term "hydraulic conductivity" has been called permeability, coefficient of permeability, field coefficient of permeability, and conductivity.[1,2]

hydrogeologic unit. Any soil or rock unit or zone which by virtue of its porosity or permeability, or lack thereof, has a distinct influence on the storage or movement of ground water.

hydroseism. Ground water level fluctuations or surges resulting from seismic events.

infiltration. The process of downward movement of water from the surface into underlying materials.

intrinsic permeability (L^{2}). The measure of the ability of a rock or soil to transmit fluid under a fluid potential gradient (see definition of hydraulic conductivity).

isotropic. The properties at any point within a medium are the same in all directions.

packer test. A method of isolating a section of a borehole by inserting one or more expandable glands (packers) in order to measure hydraulic conductivity or water quality in the section.

porosity. The property of containing interstices. Total porosity is expressed as the ratio of the volume of interstices to total volume. Effective porosity refers to the porosity through which flow occurs.[2]

practical sustained yield. The rate at which ground water can be continuously withdrawn without lowering water levels to critical stages or causing undesirable changes in water quality.

recharge. The process of water addition to the saturated zone or the volume of the water added by this process.

Safe Shutdown Earthquake (SSE). The earthquake producing the maximum vibratory accelerations at the site as defined in Title 10, Code of Federal Regulations, Part 100, Appendix A, Seismic and Geological Siting Criteria for Nuclear Power Plants.[3]

[1]Numbers in brackets refer to corresponding numbers in Section 7, References.