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COMMITTEE ACTIVITY

Committee MC-E1
on
Nuclear Principles and Applications

SURVEY OF THE CURRENT USE OF NUCLEAR GAUGES IN THE HIGHWAY FIELD
by
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INTRODUCTION

A subcommittee was appointed in late August 1967 to prepare a suitable questionnaire to send to all state highway departments in the United States and other highway departments, which may be interested, requesting information on the extent of ownership and use of nuclear gauges and other nuclear applications in conjunction with their operations. This questionnaire was patented after an earlier survey in 1964 in order to make a comparison of the extended use of nuclear devices and techniques in highway engineering.

The scope of the survey covered the ownership of nuclear gauge systems by the agencies engaged in highway construction and operation; the make, model, and uses of nuclear devices by the agencies; and a brief statement on any other activity such as the Plowshare program, nuclear energized self-luminous highway signs, cement content of portland cement concrete, etc.

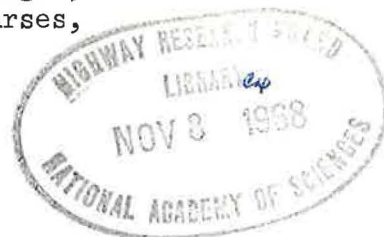
Replies to the questionnaire were received from each of the fifty states and some fifty-seven other highway agencies including nine Canadian Provinces, twelve toll authorities, and twenty-three counties.

EXPLANATION

The results of the survey are presented in two parts. Part I is a summary of the replies from the fifty state highway departments. The summary includes tabulation by states of the number and type of nuclear system owned or leased and the use being made of the units. Brief statements giving additional information on pertinent aspects of the states' responses and maps indicating the states ownership of gauges and the states' use of gauges for specification control of construction follow the tabulation.

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Part II is similar in tabulation form and informal material to Part I. The tabulation is divided into groups of agencies according to their jurisdictional organization.

PART I

RESULTS OF THE 1967 QUESTIONNAIRE ON HIGHWAY APPLICATIONS OF NUCLEAR TECHNIQUES

Additional Information on Pertinent Aspects of States' Responses
December 29, 1967

NUMBER AND TYPE OF NUCLEAR SYSTEMS POSSESSED

Ninety-four percent of the state highway departments are now or have been engaged in nuclear testing on either a research basis or a field control basis or both. Only 3 states have abstained.

A total of 379 surface moisture-density testing systems were reported as being in the possession of 44 departments. (The word "systems" in this case means a combination of scaler and probes for a particular testing purpose.)

The California Division of Highways leads in this category with 72 systems. Pennsylvania is second with 54 surface systems, Louisiana is third with 31, Virginia is fourth with 25, Wisconsin is fifth with 21, and Illinois is sixth with 19 surface systems.

Twenty-seven state highway departments are operating 126 nuclear units for the purpose of density testing of asphalt pavements.

Nine states reported the possession of nuclear asphalt content equipment. One such device was reported in each of these states. Seventeen state highway departments have nuclear depth moisture-density devices. Nine states have, at one time or another, used a total of 16 nuclear road logging devices of the type that travel over the surface automatically recording moisture-density data.

SPECIFICATION AND NON-SPECIFICATION USAGE

Fifty-six percent (28 states) reported using nuclear equipment for specification material control. Nine states use nuclear asphalt density tests for specification material control.

This should not be construed to indicate any of these states use nuclear testing exclusively. When taking into consideration the number of devices listed by these states, it is obvious no state highway department having nuclear testing in their specifications actually requires its use except in some cases by special provision.

Nineteen states use the nuclear method for non-specification checks. Of these 19 there are 13 states also using the nuclear method for specification material control.

LABORATORY AND FIELD RESEARCH

Eighteen states use the gauges for laboratory research and 28 for field research. Of all these states, 18 use the equipment for specification control while the research is proceeding.

Seventeen state highway departments currently have research projects in the field of nuclear testing underway.

No special nuclear projects such as nuclear excavation, self luminous signs, etc. were reported in progress.

1962 - 1964 - 1967 COMPARISON

The following data is a brief comparison of the results of the three nuclear questionnaires that have been distributed by the Highway Research Board in the past five years:

USA STATE HIGHWAY DEPARTMENTS ENGAGED IN NUCLEAR TESTING:

<u>1962</u>	<u>1964</u>	<u>1967</u>
56 %	74 %	94 %

NUCLEAR TESTING USED FOR SPECIFICATION MATERIAL CONTROL:

<u>1962</u>	<u>1964</u>	<u>1967</u>
14 %	24 %	56 %

NUCLEAR TESTING USED FOR DENSITY DETERMINATION OF ASPHALTIC PAVEMENTS:

<u>1962</u>	<u>1964</u>	<u>1967</u>
0 states	11 states	27 states
0 gauges	19 gauges	126 gauges

HIGHWAY RESEARCH BOARD COMMITTEE MC-EI

TABULATION OF RESULTS OF 1967 NUCLEAR QUESTIONNAIRE FROM U.S. HIGHWAY DEPARTMENTS

SURFACE M-D SYSTEMS	ASPHALT DENSITY PROBES	ASPHALT CONTENT DEVICE	DEPTH M-D SYSTEMS	NUCLEAR SYSTEMS LEASED	ROAD LOGGING DEVICE	LAB RESEARCH	FIELD RESEARCH	NON-SPEC. CHECK OF MATL.	SPEC. CONTROL OF MATL.	CALIBRATION METHODS MFG'S CURVE	OTHER METHOD	AIR GAP RATIO	CURRENT RESEARCH UNDER WAY
ALABAMA	2	1	1					X	X	X		X	NO
ALASKA	1			1				X	X				NO
ARIZONA	1					X	X	X	X				NO
ARKANSAS	72	42*						X	X				NO
CALIFORNIA	15	7	1	1	1		X	X	X	X			YES
CONNECTICUT	15	5	1			X	X	X	X	X		X	YES
DELAWARE	1						X			X			YES
FLORIDA	7**	2	1			X	X		X	X			NO
GEORGIA	1					X							YES
HAWAII	2	1					X			X		X	YES
IDAHO	2	1		1		X	X	X		X			NO
ILLINOIS	19	4	1			X	X		X	X			NO
INDIANA	3						X			X			YES
IOWA	1				1			X					NO
KANSAS	1		1										NO
KENTUCKY	4	1	1					X	X	X			NO
LOUISIANA	31	1	1			X	X	X	X	X			NO
MAINE	2		1				X	X	X			X	NO
MARYLAND	5	1				X	X	X	X	X		X	YES
MASSACHUSETTS	0	—	—	—	—	—	—	—	—	—		—	NO
MICHIGAN	6	1	1			X	X		X	X		X	YES
MINNESOTA	1									X			NO
MISSISSIPPI	0	—	—	—	—			—	—	—		—	NO
MISSOURI	0	—	—	—	—	—	—	—	—	—		—	NO
MONTANA	11	1	1			X	X	X	X	X		X	NO
NEBRASKA	1	1				X	X			X		X	YES
NEVADA	0				1								NO
NEW HAMPSHIRE	1	1					X			X			NO
NEW JERSEY	2**							X	X				NO
NEW MEXICO	1							X	X	X		X	NO
NEW YORK	0	1		1	1		X			X			NO
NORTH CAROLINA	4	1					X			X		X	NO
NORTH DAKOTA	3								X	X		X	NO
OHIO	18	2	1***				X	X	X	X		X	YES
OKLAHOMA	2		2	4	4			X	X	X			YES
OREGON	1		1					X	X	X			NO
PENNSYLVANIA	54	30	1			X	X	X	X	X		X	YES
RHODE ISLAND	4									X			NO
SOUTH CAROLINA	1					X				X			NO
SOUTH DAKOTA	1		1				X		X				YES
TENNESSEE	5							X	X	X			NO
TEXAS	11	1		2	2		X	X	X	X			YES
UTAH	4	7	1	4	4	X	X	X	X	X			NO
VERMONT	2												NO
VIRGINIA	25	1				X		X	X	X		X	YES
WASHINGTON	0	—	—	—	—	—	—	—	—	—		—	NO
WEST VIRGINIA	4	4	1			X	X	X	X	X		X	NO
WISCONSIN	21					X	X	X	X	X		X	YES
WYOMING	10	2					X	X	X	X			YES
TOTALS	379	126	9	17	16	18	28	19	28	28	35	15	17

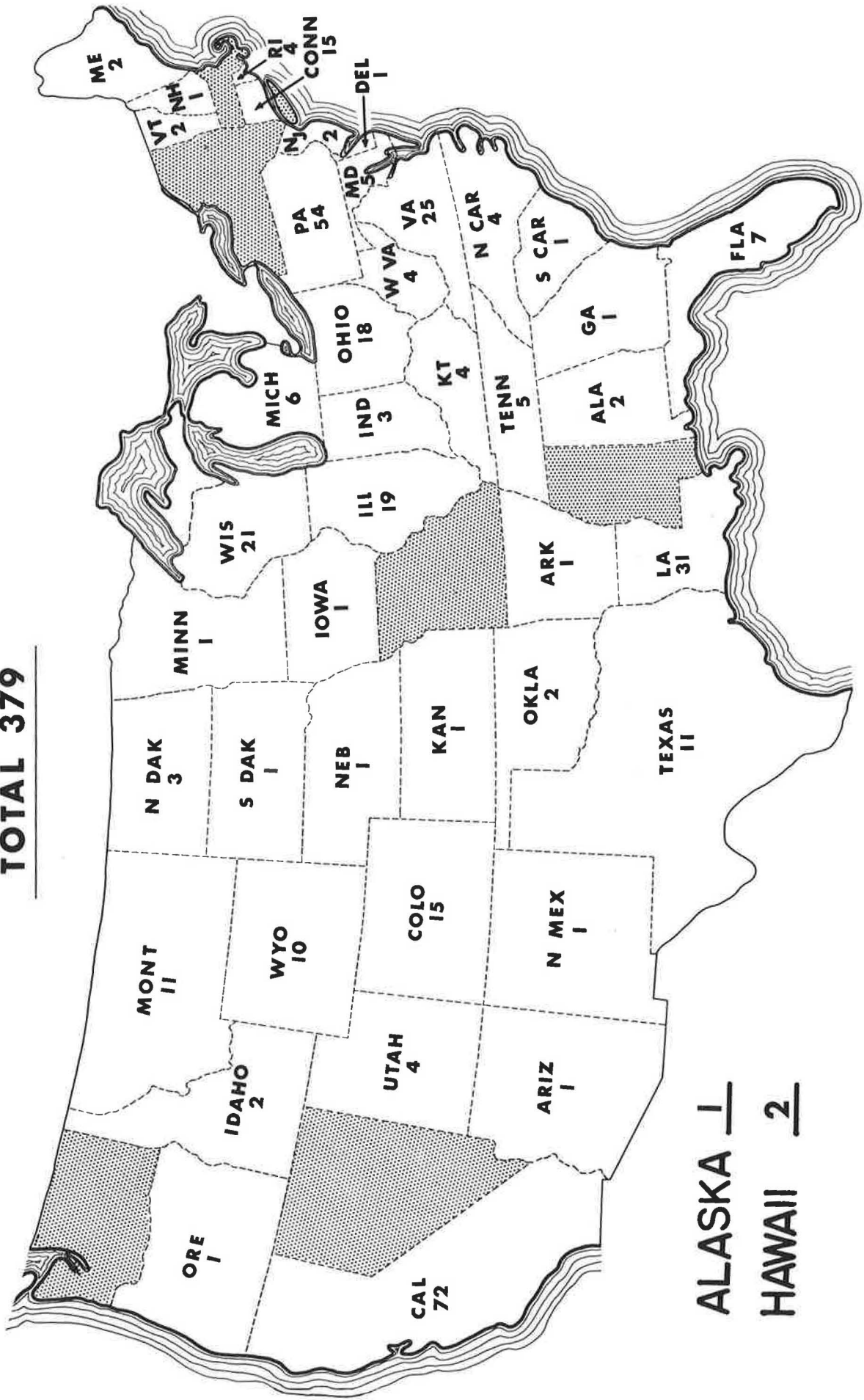
ALABAMA

* CALIFORNIA: 1 PROBE SPECIFICALLY FOR ASPHALT DENSITY TESTING. THE REMAINING 41 ARE BASICALLY SOIL GAUGES, ALSO USED FOR ASPHALT PAVEMENT DENSITY TESTING.
 ** SURFACE DENSITY PROBES ONLY.
 *** OHIO: DEPTH MOISTURE PROBE ONLY.

USA STATE HIGHWAY DEPARTMENTS

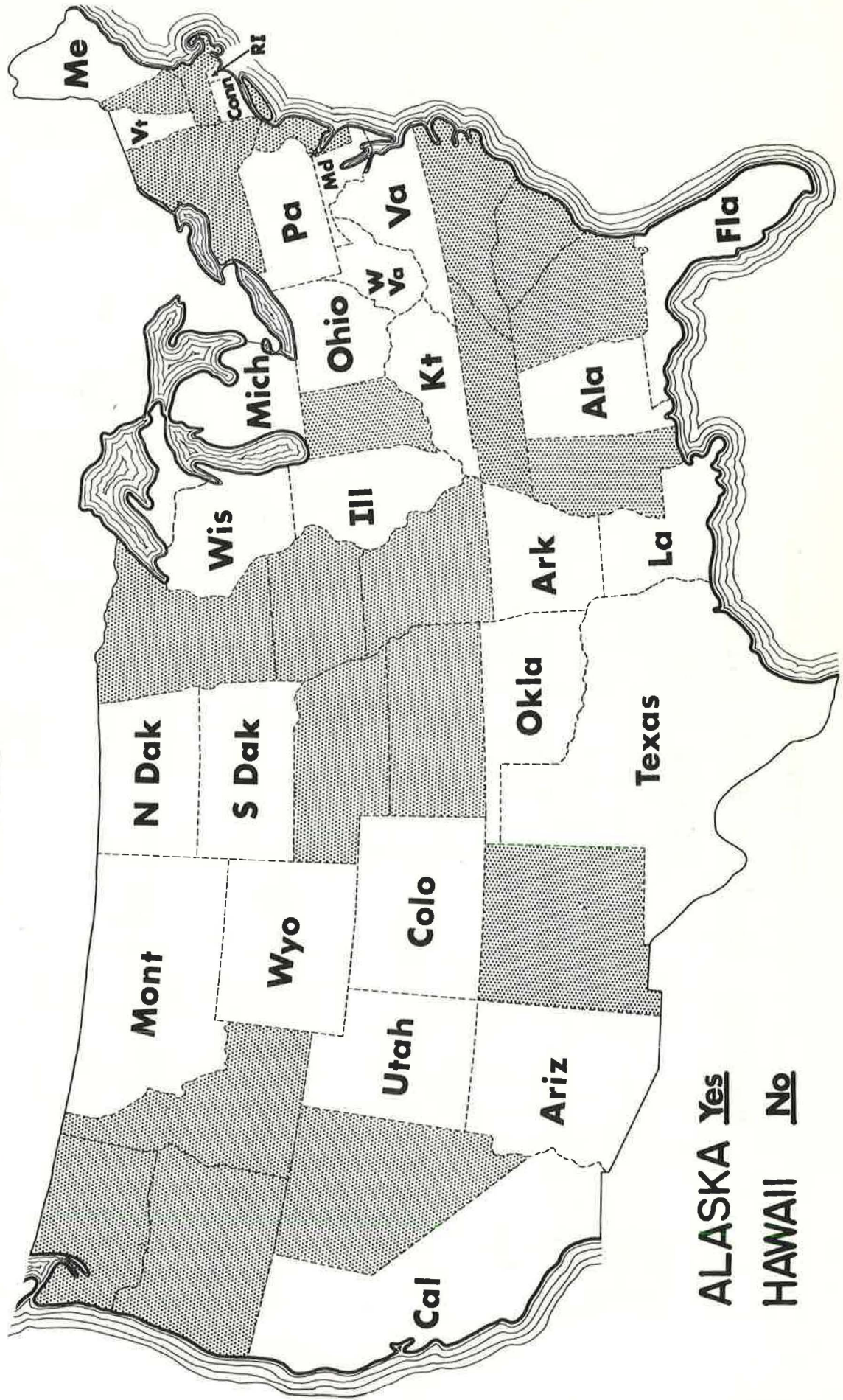
Nuclear Surface M/D Systems In Use - 1967

TOTAL 379



STATE HIGHWAY DEPARTMENTS
**Nuclear Systems Used For Specification Material Control
of Soils, Aggregates, and/or Asphalt**

1967 TOTAL: 28



ALASKA Yes
HAWAII No

PART II

RESULTS OF THE 1967 QUESTIONNAIRE ON
HIGHWAY APPLICATIONS OF NUCLEAR TECHNIQUES

Additional Information on Pertinent Aspects of Agencies' Responses
December 29, 1967

The results contained herein stem from questionnaire responses of road departments, and several other miscellaneous agencies.

Several of the Turnpike Authorities and city and county road departments contacted indicated that they used nuclear testing services of their respective state highway departments. Some indicated a desire to initiate their own nuclear testing in the future. The results contained in this report pertain only to systems in operation at the end of 1967.

CANADIAN PROVINCES:

Number and Type of Nuclear Systems Possessed

Six of the nine Canadian provinces responding indicated use of nuclear measurement techniques.

A total of 14 surface moisture-density testing systems were in use by five of the provinces. Quebec led in this category with eight systems in operation at the end of 1967. Depth moisture-density systems, four in all, were being used by three of the Provincial Highway Departments.

Three of the provinces were using a total of five asphalt density probes. There were no users of nuclear asphalt content equipment.

Three road-logging devices were being used, one each, by three provinces.

Specification and Non-Specification Usage

Three of the Canadian provinces reported use of nuclear systems for specifications material control. Five of the provinces, including two of the above, reported use of nuclear systems for non-specification material control.

Research

Four provinces were engaged in field research using nuclear gauges. None of the provinces reported any laboratory research by December 1967. Saskatchewan was continuing an evaluation of road logging devices. No other special projects were reported.

TURNPIKE AND PORT AUTHORITIES:

Of the twelve agencies responding in this category, only the Port Authority of New York was engaged in the nuclear testing. Their work involved the use of two surface moisture-density systems for specification material control.

CITY AND COUNTY ROAD DEPARTMENTS:

Six of the thirty-two city and county road agencies responding to the questionnaire were conducting studies involving nuclear techniques.

Eleven surface moisture-density systems were in use by these six agencies. Three agencies were using a depth moisture-density system and two asphalt density probes were in use by two agencies. None of the agencies were utilizing nuclear asphalt content devices.

One road department reported to be conducting field research. No one in this category reported any laboratory research.

All six agencies were conducting specification control of material by nuclear techniques. One of them reported both specification and non-specification checks. None of the city or county road departments had any special nuclear research underway at the time of the inquiry.

OTHER AGENCIES:

The American Association of Railroads reported the use of a moisture-density system for field research and non-specification material checking.

A portable nuclear moisture-density system and a road logger were used by the Illinois Institute of Technology in a soil compaction study sponsored by the Bureau of Public Roads. Both laboratory and field research were reported.

Ohio State University reported use of both surface and depth moisture-density systems.

SUMMARY TABULATION

Agencies:	Surface M-D Systems	Asphalt Density Probes	Asphalt Content Devices	Depth M-D Systems	Nuclear Systems Leased	Road Logging Devices
Canadian Provinces	14	5	0	4	12	3
Turnpike and Port Authorities	2	0	0	0	0	0
U.S. Cities	4	2	0	2	0	0
U.S. Counties	6	0	0	1	0	0
Others	2	0	0	1	0	1
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TOTAL	28	7	0	8	12	4
	=====	=====	=====	=====	=====	=====

TABULATION OF RESULTS OF 1967 NUCLEAR QUESTIONNAIRE FROM CANADIAN HIGHWAY DEPARTMENTS, TURNPIKE AUTHORITIES, U.S. CITIES AND COUNTIES

	Surface M-D Systems	Asphalt Density Probes	Asphalt Content Device	Depth M-D Systems	Nuclear Systems Leased	Road Logging Device	Lab Research	Field Research	Non-Spec. Check of Material	Spec. Control of Matl.	Calibration Methods			Current Research Under- Way
											MFG.'s Curve	Other Method	Air Gap Ratio	
Canadian Highway Depts.														
Alberta	1			1	1	1		X	X		X	X		
Manitoba	1				2	1		X	X		X		X	NO
New Brunswick		1							X		X			
Nova Scotia	0	-	-	-	-	-	-	-	-	-	-	-	-	NO
Ontario	3	2		2	2			X	X	X	X		X	NO
Prince Edward Island	0	-	-	-		-	-	-	-	-	-	-	-	NO
Quebec	8	2		1	6					X	X		X	NO
Saskatchewan	1				1	1		X	X	X	X		X	YES
British Columbia	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	14	5	0	4	12	3								
Turnpike Authorities														
Delaware River and Bay Authority	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Illinois Toll Comm.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Mass. Turnpike Authority	0	-	-	-	-	-	-	-	-	-	-	-	-	-
N. J. Turnpike Authority	0	-	-	-	-	-	-	-	-	-	-	-	-	-
N. Y. Thruway Authority	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Ohio Turnpike Comm.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Oklahoma Turnpike Authority	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Pennsylvania Turnpike Comm.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Port of N. Y. Authority	2									X	X	X	-	-
Richmond-Petersburg Turnpike Auth. (Va.)	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Texas Turnpike Authority	0	-	-	-	-	-	-	-	-	-	-	-	-	-
West Virginia T.C.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2	0	0	0	0	0								
Cities														
Baltimore	1	1								X	X			NO
Chicago	0		-	-	-	-	-	-	-	-	-	-	-	NO
Dallas	0		-	-	-	-	-	-	-	-	-	-	-	-
Denver	3	1		1						X		X		NO
Detroit	0		-	-	-	-	-	-	-	-	-	-	-	-
Pittsburgh	0	-	-	-	-	-	-	-	-	-	-	-	-	-
San Diego	0	-	-	-	-	-	-	-	-	-	-	-	-	-
San Francisco	1			1				X		X	X			NO
Seattle	0	-	-	-	-	-	-	-	-	-	-	-	-	NO
Total	4	2	0	2	0	0								
Counties														
Baltimore Co., Md.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Bergen Co., N. Y.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Bexar Co., Texas	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Cook Co., Ill.	4									X		X		NO
Cuyahoga Co., Ohio	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Dade Co., Fla.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Duval Co., Fla.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Erie Co., N. Y.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Hillsboro Co., Fla.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Los Angeles Co., Calif.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Montgomery Co., Md.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Montgomery Co., Ohio	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Multnomah Co., Ore.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Nassau Co., N. Y.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Oakland Co., Mich.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Orange Co., Calif.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Sacramento Co., Calif.	0	-	-	-	-	-	-	-	-	-	-	X	-	NO
San Diego Co., Calif.	1			1					X	X	X			-
Santa Clara Co., Calif.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Suffolk Co., N. Y.	1									X	X		X	NO
Union Co., N. J.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Wayne Co., Mich.	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Westchester Co., N. Y.	0													-
Total	6	0	0	1	0	0								
Miscellaneous														
Assoc. of Amer. Railroads IIT (Ill.)	1					1	X	X	X		X		X	NO
Ohio State Univ.	1			1	0	1		X				X		NO
Total	2	0	0	1	0	1								NO

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