FLOODS
ON
NOLICHUCKY RIVER
AND
NORTH & SOUTH INDIAN CREEKS

IN VICINITY OF
ERWIN
TENNESSEE

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

TENNESSEE VALLEY AUTHORITY
KNOXVILLE, TENNESSEE 37902

May 26, 1967

Mr. Harold V. Miller, Executive Director
Tennessee State Planning Commission
C2-208 Central Services Building
Nashville, Tennessee 37219

Dear Mr. Miller:

In response to the request of the Erwin Regional Planning Commission through the Tennessee State Planning Commission, TVA has prepared the report, "Floods on Nolichucky River and North and South Indian Creeks in Vicinity of Erwin, Tennessee." The purpose of this report is to provide basic information on floods that have occurred or may occur which would be helpful in the state and local programs of planning and development in the region of Erwin. We are furnishing you copies of the report for distribution to the appropriate state and town agencies and individuals.

Also, copies of the report are being furnished interested Federal agencies for their information and use.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

Reed A. Elliot, Director
Division of Water Control
Planning

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

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ERWIN, TENNESSEE

REPORT NO. 0-6589

KNOXVILLE, TENNESSEE
MARCH 1967

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Tennessee Valley Authority
Division of Water Control Planning

FOREWORD

This report relates to the flood situation along Nolichucky River, North Indian Creek, and South Indian Creek in the vicinity of Erwin, Tennessee. It has been prepared at the request of the Erwin Regional Planning Commission through the Tennessee State Planning Commission to aid (1) in the solution of local flood problems and (2) in the best utilization of land subject to overflow. Data assembled by TVA on rainfall, runoff, historical and current flood heights, and other technical information bearing upon the occurrence and magnitude of floods in localities throughout the region provide the basis for this report.

The report does not include plans for the solution of flood problems. Rather, it is intended to provide the basis for further study and planning on the part of the Town of Erwin in arriving at solutions to minimize vulnerability to flood damages. This might involve (1) the construction of flood protection works, (2) local planning programs to guide developments by controlling the type of use made of the flood plain through zoning and subdivision regulations, or (3) a combination of the two approaches.

The report covers three significant phases of the Erwin flood problem. The first brings together a record of the largest known floods of the past on Nolichucky River, North Indian Creek, and South Indian Creek. The second treats of Regional Floods. These are derived from consideration of the largest floods known to have occurred in the same general geographical region as the three streams and generally within 80 miles of Erwin. The third develops the Maximum Probable Floods for these streams. Floods of this magnitude on most streams are considerably larger than any that have occurred in the past. They are the floods of infrequent occurrence that are considered in planning protective works, the failure of which might be disastrous.

The report contains maps, profiles, and cross sections which indicate the extent of flooding that has been experienced and that might occur in the future in the vicinity of Erwin. This should be useful in planning future developments in

the flood plains. Structures or building floor levels may be planned either high enough to avoid flood damage or at lower elevations with recognition of the chance and hazards of flooding that are being taken.

I.

SUMMARY OF FLOOD SITUATION

Erwin, Tennessee, is located on the right bank of the Nolichucky River 95 miles above its confluence with the French Broad River in Douglas Lake. North Indian Creek, a tributary with a drainage area of 59.3 square miles, joins the Nolichucky River at Erwin. South Indian Creek, with a drainage area of 81.0 square miles, flows into the river from the left bank, across the river from Erwin.

This investigation covers the Nolichucky River from the Unicoi-Washington County line at Mile 92.7 to the community of Unaka Springs at Mile 98.3. North Indian Creek is covered from the mouth to Mile 9.4, the mouth of Dick Creek. South Indian Creek is covered from the mouth to Mile 4.2, the mouth of Granny Lewis Creek.

The principal business and residential development of Erwin is on high ground east of the river, but there are important industrial, commercial, and residential developments on land along Nolichucky River and North Indian Creek. There is also some development on land along South Indian Creek. Portions of this land along the three streams have been inundated by floods of the past, and a substantially greater area is within reach of the greater floods of the future.

Stream gaging stations on the Nolichucky River have been maintained by the U. S. Geological Survey or the U. S. Weather Bureau with few interruptions since September 1900. A recording stream gage on North Indian Creek was operated by the Geological Survey from May 1944 to September 1957, and a crest-stage partial-record station has been maintained at the same site since October 1958. No records of streamflow have been maintained on South Indian Creek.

In compiling a record of the early floods on the streams, it has been necessary to interview residents along the streams who have knowledge of past floods and to conduct research in newspaper files and historical documents. From these investigations and from studies of possible future floods on the streams in the vicinity of Erwin, the flood situation, both past and future, has

been developed. The following paragraphs summarize the significant findings with regard to the flood situation which are discussed in more detail in succeeding sections of this report.

* * *

THE GREATEST FLOOD known to have occurred on Nolichucky River at Erwin was on May 21, 1901. Record floods probably occurred on North and South Indian Creeks at the same time. There was considerable overflow with high velocities along the streams, and damages were great in spite of limited development.

* * *

ANOTHER GREAT FLOOD occurred on the Nolichucky River on August 13, 1940. In the vicinity of Erwin it was about 4 feet lower than the 1901 flood.

* * *

OTHER LARGE FLOODS on Nolichucky River occurred in September 1824, March 1867, February 1875, March 1899, and February 1902. Large floods probably occurred on North Indian Creek at the same time, but the highest stages reached during the period of gage record were on March 12, 1963, and March 26, 1965. Large floods occurred on South Indian Creek on those dates also.

* * *

REGIONAL FLOODS on Nolichucky River, North Indian Creek, and South Indian Creek in the vicinity of Erwin are based upon floods experienced on streams within 80 miles of the city, a number of which are larger than any known floods on the three streams. This indicates that greater floods than those known to have occurred may reasonably be expected in the future. Based upon the magnitude of floods that have occurred on neighboring streams, a Regional Flood on Nolichucky River would be about 2 feet higher than the 1940 flood, but 2 feet lower than the 1901 flood, in the vicinity of Erwin. On North Indian Creek a Regional Flood would average almost 8 feet higher than the 1965 flood. A Regional Flood on South Indian Creek would exceed the 1965 flood by an average of about 6 feet.

* * *

MAXIMUM PROBABLE FLOOD determinations indicate that floods could occur on Nolichucky River that would exceed the 1901 flood in the vicinity of Erwin by about 7 feet. On North Indian Creek the Maximum Probable Flood would be 3 to 19 feet higher than the 1965 flood, averaging about 10 feet higher. The Maximum Probable Flood on South Indian Creek would be 6 to 16 feet higher than the March 26, 1965, flood.

* * *

FLOOD DAMAGES that would result from a recurrence of a flood as large as that of 1901 on the Nolichucky River would be substantial because of the increased development on the flood plains. Historical floods on North and South Indian Creeks have not caused great damage, but extensive damages would be caused along both creeks by the Regional Flood, and along all three streams by the Maximum Probable Flood, because of their greater depths and velocities.

* * *

MOST FREQUENT FLOOD OCCURRENCES on the streams in the vicinity of Erwin have been in the winter and spring months, or in July, August, or October. Most of the floods have resulted from general heavy rainfall. However, some of the highest floods have occurred in the summer, and large floods may occur any time.

* * *

VELOCITIES OF WATER during the August 1940 flood ranged up to more than 15 feet per second in the channel and 5 feet per second on the flood plain of Nolichucky River. Along North Indian Creek, velocities during the March 26, 1965, flood were up to 10 feet per second in the channel and 3 feet per second on the flood plain. During the March 1965 flood on South Indian Creek, channel and flood-plain velocities ranged up to 10 and 4 feet per second, respectively. During a Maximum Probable Flood, velocities in the channels of the three streams would range up to more than 15 feet per second, and on the flood plains the velocities would range up to 8 feet per second. These high velocities would be extremely dangerous to life and property.

* * *

DURATION OF FLOODS is relatively short on all streams in the vicinity of Erwin. During the flood of August 1940, Nolichucky River had a maximum rate of rise of more than 4 feet per hour, and remained out of banks for 24 hours. During a Maximum Probable Flood on Nolichucky River, the stream would rise 31 feet in 15 hours with a maximum rate of rise of 4 feet per hour, remaining out of banks for about 44 hours. On North Indian Creek the Maximum Probable Flood would rise 18 feet in 7 hours with a maximum rate of rise of 4 feet in 1 hour, and the stream would remain out of banks for 34 hours. South Indian Creek would rise 22 feet in 8 hours with a maximum rate of rise of 7 feet per hour, and would remain out of banks for 31 hours during a Maximum Probable Flood.

* * *

HAZARDOUS CONDITIONS would occur during large future floods as a result of the rapidly rising streams, high velocities, and deep flows.

* * *

FUTURE FLOOD HEIGHTS that would be reached if floods of the magnitude of the Regional and Maximum Probable occurred in the vicinity of Erwin are shown in Table 1. The table compares these flood crests with the crest of a historical flood at each location.

TABLE 1

RELATIVE FLOOD HEIGHTS

Flood	Location	Mile above Mouth	Estimated Peak Discharge cfs	Above 1940 or 1965 Flood feet
	Nolichucky River			
August 13, 1940	Erwin (Above North Indian Creek)	94.1	78,000	0
Regional			95,500	2.3
May 21, 1901			109,000	4.5
Maximum Probable			190,000	10.8
	North Indian Creek			
March 26, 1965	Erwin (Tennessee Highway 81)	1.22	3,100	0
Regional			26,500	11.9
Maximum Probable			43,000	13.1
March 26, 1965	Unicoi (U. S. Highway 19W & 23)	6.75	1,200	0
Regional			20,000	13.3
Maximum Probable			34,000	14.9
	South Indian Creek			
March 26, 1965	Near Erwin (Bridge at Shallowford Church)	3.14	8,000	0
Regional			31,000	5.0
Maximum Probable			54,000	7.8

II.

THE WATERSHED AND REGION

Erwin, the county seat of Unicoi County, is located on the east side of the Nolichucky River 6 miles downstream from the Tennessee-North Carolina state line. North and South Indian Creeks, the first major tributaries below the state line, flow into the river in the vicinity of Erwin. The Nolichucky River watershed above Erwin lies in the Appalachian Mountains with elevations reaching over 6,000 feet. The city is located in the foothills of these mountains at an elevation near 1,600 feet. The Nolichucky River is the largest tributary of the French Broad River, one of the major tributaries of the Tennessee River.

This section of the report includes a brief history of the region and descriptions of the streams and watersheds covered by this report.

Settlement

The Cherokee Indians occupied or hunted this area before the hunters and early Indian traders made their way this far westward. It is believed that Daniel Boone crossed the Blue Ridge in the vicinity of Altapass and traveled down the North Toe River on one or more of his trips from North Carolina to Kentucky. He avoided the Nolichucky gorge by crossing Iron Mountain and following North Indian Creek to the Nolichucky River. He then went across country to the Kingsport area.

One of the first settlers in this area was Jacob Brown who purchased all of Unicoi, part of Greene, and nearly half of Washington Counties from the Indians and settled along the Nolichucky River in 1771. He began selling portions of his land to settlers from Virginia and the Carolinas, and in 1772 John Sevier built a home in the Nolichucky valley below Embreeville. As the early settlers moved in they found evidence of several Indian settlements along the banks of the creeks in the Erwin vicinity and named them North Indian Creek and South Indian Creek. By 1778, Webbs, Martins, Actons, Deakens, Hamptons, Loves, and Lewises had settled in what was known as Greasy Cove. This name was given to the North Indian Creek valley between Unicoi and Nolichucky River because it was known by the early hunters for its ample supply of bears which were killed and the

grease cooked out for various uses. The first road through the area was built in 1778 from Johnson City through Unicoi and Limestone Cove and across Iron Mountain.

The first post office in the Greasy Cove area was called Unaka, an Indian name for "white," referring to the mountains in the area. On July 15, 1840, the name was changed to Longmire in honor of the postmaster. On March 27, 1876, the name was officially changed to Vanderbilt in the hope that the Vanderbilts would invest money in the area. After this failed, the name of the town was again changed on December 5, 1879, to Ervin in honor of D. J. N. Ervin, who had donated 15 acres of land to the county. The post office officials made a mistake in recording the name, and in 1903 the incorrect spelling of Erwin was made official.

The first school in the area of Unicoi was conducted on the Solomon Jones Plantation in about 1838. The town there was first called Head of the Big Lane, then Swingleville, Limontie, Unicoi City, and finally Unicoi. Above Unicoi the early settlers built lime kilns along the edge of the cove, thus the name Limestone Cove in the headwaters of North Indian Creek.

Unicoi County was formed by a legislative act approved March 23, 1875. About two-thirds of the county was formed from the mountain section of Washington County and the other third from Carter County. The total area was 201 square miles, with the first county seat at Longmire. At that time there were about 30 families, three saloons, and one church in the community. In 1888 Erwin was connected to Johnson City by the Charleston, Cincinnati and Chicago Railway. A wooden boxcar was converted into a depot and a "short dog" carrying freight and one passenger car operated between Johnson City and Erwin.

On April 10, 1903, Erwin was granted a charter incorporating the town. In 1908 the railroad consolidated with several other companies forming the Carolina, Clinchfield, and Ohio Railroad, commonly known today as the Clinchfield Railroad, with tracks from Spartanburg, South Carolina, to Elkhorn City, Kentucky. The division point of the company was soon moved from Johnson City to Erwin, lending strength to the economy of the area and boosting the population to 1149 in 1910. The Bank of Erwin was established in 1909, and between 1911 and 1915 the town granted franchises to light, water, and telephone companies. The population of Erwin has grown slowly to 3210 in 1960.

The Nolichucky River and Its Valley

The watershed of the Nolichucky River upstream from the U. S. Geological Survey stream gage at Embreeville, Tennessee, is shown on Plate 1. More than three-fourths of that watershed lies in the rugged mountains of western North Carolina, with three major tributaries in the headwaters of the river. The North Toe River rises along the Blue Ridge and flows in a northwesterly direction, and the South Toe and Cane Rivers flow in northerly directions to join the North Toe River. The Nolichucky River is formed by the confluence of the North Toe and Cane Rivers about 16 miles upstream from Erwin. For most of that distance the river flows through a gorge, but the valley floor widens in the Erwin vicinity.

The drainage area shown is roughly 28 miles square, and is bounded on the southeast by the Blue Ridge, which marks the Tennessee Valley Divide. Elevations along it range from 3,000 feet up to 5,665 feet at the Pinnacle, in the southern corner, and 5,240 feet at Sugar Mountain in the eastern corner. The Blue Ridge, Black Mountains, and Bald Mountain mark the southwestern rim of the watershed with elevations ranging from 3,000 to 5,000 feet. However, just inside the southern rim is Mount Mitchell at 6,684 feet, the highest point in eastern United States.

Along the northern rim, elevations range from 2,000 feet near Unicoi to 6,285 feet at Roan High Knob. Rich, Buffalo, and Little Mountains, with elevations up to more than 4,800 feet, separate the watershed shown on Plate 1 from the lower Nolichucky basin.

From the high elevations around the rim, the streams in the watershed drop rapidly to the valley floor which is at an elevation near 2,500 feet at Spruce Pine, North Carolina, and 2,000 feet at the head of the Nolichucky River. In the vicinity of Erwin the flood-plain elevation is between 1,600 and 1,700 feet. Erwin lies on the east side of the river, but the corporate limits do not reach the stream.

This investigation covers the Nolichucky River from the Unicoi-Washington County line at Mile 92.7 to Unaka Springs at Mile 98.3. In this reach the river falls from elevation 1,680 to 1,571 feet, at a fairly uniform rate of 20 feet per mile. Upstream from the old U. S. Highway 19W & 23 bridge at

Mile 97.4, and downstream from the mouth of North Indian Creek at Mile 94.1, the flood plain of the Nolichucky River is narrow, varying in width from 400 to 800 feet. In the vicinity of Erwin the flood plain is wider, reaching a maximum width of about 3,000 feet upstream from the mouth of South Indian Creek.

Pertinent drainage areas of Nolichucky River and its tributaries are given in Table 2.

TABLE 2

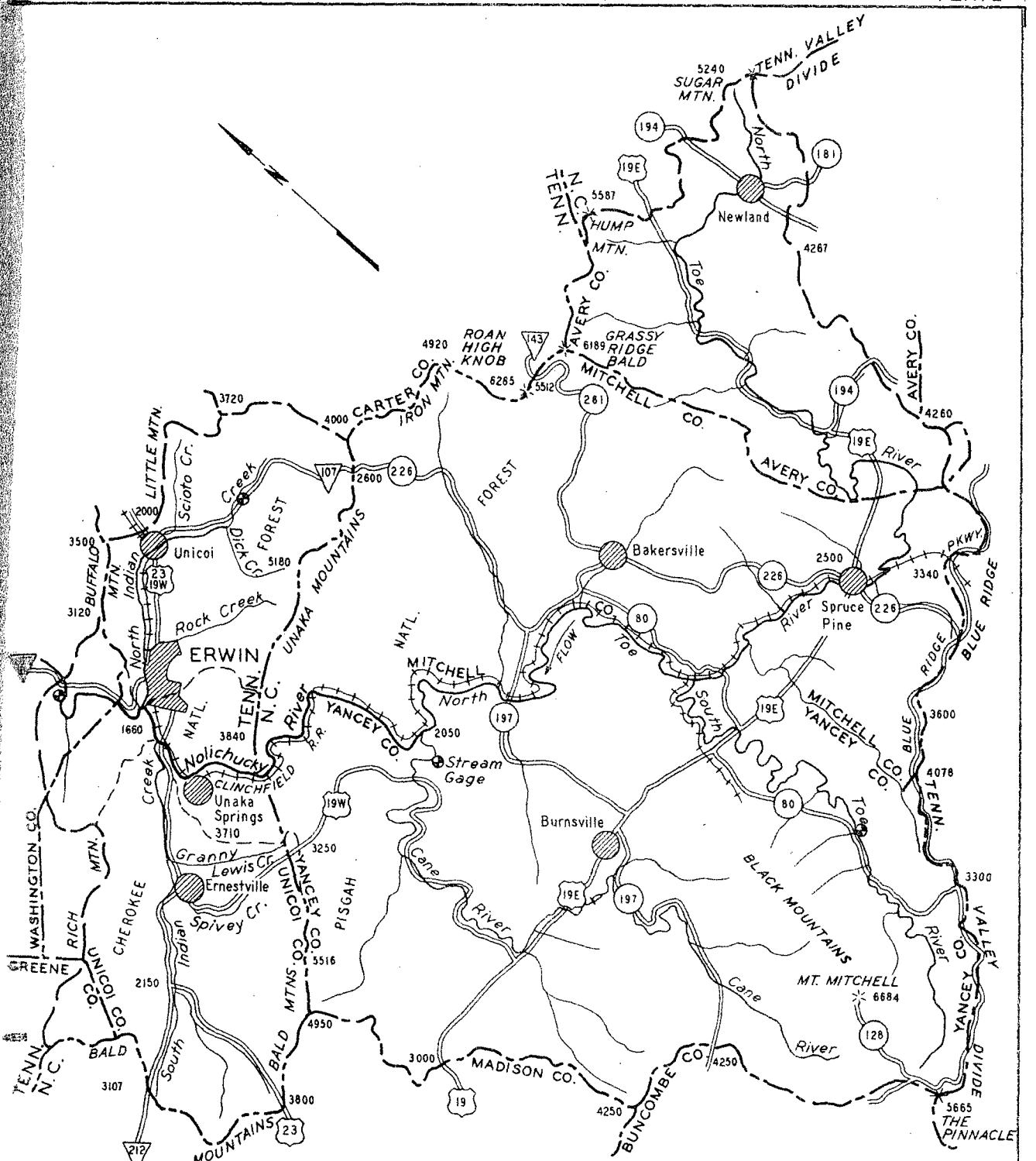
DRAINAGE AREAS IN WATERSHED OF NOLICHUCKY RIVER

Stream	Location	Mile above Mouth	Drainage Area sq. mi.
Nolichucky River	Mouth	0.0	1756
	Nolichucky Dam	46.0	1183
	USGS stream gage at Embreeville	89.0	805
	Washington-Unicoi County line (lower limit of study)	92.7	791
	Above North Indian Creek	94.1	727
	Above South Indian Creek	95.6	639
	Clinchfield Railroad at Unaka Springs	98.0	636
	Tennessee-North Carolina state line	100.8	626
	Below junction Cane and North Toe Rivers (head of river)	110.8	600
North Indian Creek	Mouth	0.0	59.3
South Indian Creek	Mouth	0.0	81.0
North Toe River	Mouth	0.0	442
Cane River	Mouth	0.0	158

North Indian Creek and Its Valley

North Indian Creek, with a drainage area of 59.3 square miles, all of which is in Unicoi County, Tennessee, heads along Iron Mountain about 12 miles northeast of Erwin. The watershed is shown on Plate 1. Elevations along

PLATE



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UPPER NOLICHUCKY RIVER WATERSHED

SCALE 0 5 10 MILES

MARCH 1967

the Unaka Mountains, which mark the southern rim of the watershed and form the state boundary between Unicoi and Mitchell Counties, range from 2,600 to 5,200 feet. Elevations along the eastern rim of the valley dividing Unicoi and Carter Counties, Tennessee, are near 4,000 feet. On the north edge of the valley Buffalo and Little Mountains form the divide with elevations varying from 3,500 feet on Buffalo Mountain down to 2,000 feet near Unicoi. From the rugged and heavily wooded sides of the Unaka Mountains, the creek flows in a westerly direction dropping to an elevation of 2,380 feet at Limestone Cove and 1,920 feet at Unicoi. There it turns and flows in a southwesterly direction to its mouth near Erwin. North Indian Creek has three major tributaries, Scioto Creek flowing in from the right just upstream from Unicoi, and Dry Branch and Rock Creek flowing in from the left between Unicoi and Erwin.

This investigation covers North Indian Creek from the mouth through Unicoi to Mile 9.38. In this reach the stream falls from elevation 2,112 feet to 1,606 feet at an average rate of 54 feet per mile, the slope gradually decreasing from nearly 80 feet per mile in the upper end to about 40 feet per mile near the mouth. Upstream from Unicoi, the flood plain varies in width from 200 to 1,800 feet, the narrowest sections being in the upper end of the reach. The flood plain at Unicoi is about 1,600 feet wide, and between Unicoi and Erwin it ranges from 500 to 2,200 feet in width, with the widest section in the Fishery community. In Erwin the flood-plain width varies from 500 feet at Mile 1.6 to 3,000 feet near Tennessee Highway 81 at Mile 1.22. The creek marks the northwest corporate limits of Erwin from Mile 0.20 to Mile 1.78, a distance of 1.58 miles.

Pertinent drainage areas of North Indian Creek are given in Table 3.

TABLE 3

DRAINAGE AREAS IN WATERSHED OF NORTH INDIAN CREEK

Stream	Location	Mile above Mouth	Drainage Area sq. mi.
North Indian Creek	Mouth	0.0	59.3
	Tenn. Highway 81	1.22	57.3
	U. S. Highway 19W & 23	6.75	32.7
	Below Dick Creek (upper limit of study)	9.38	23.6
	USGS stream gage	10.80	15.9

South Indian Creek and Its Valley

South Indian Creek with a drainage area of 81.0 square miles, 95 percent of which is in Unicoi County, Tennessee, has a roughly rectangular watershed 8 miles wide and 10 miles long. The stream heads on the heavily wooded slopes of the Bald Mountains and flows in a northeasterly direction to the Nolichucky River near Erwin. The Bald Mountains form the watershed rim on the southeast and southwest sides and mark the boundary between Unicoi County, Tennessee, and Yancey and Madison Counties in North Carolina. Elevations range from 5,500 feet on top of Big Bald Mountain down to 3,100 feet at Devil Fork Gap. On the northwest, Rich Mountain divides South Indian Creek from the lower Nolichucky River basin with elevations ranging from 2,400 to 4,800 feet. The largest tributary is Spivey Creek, which flows into South Indian Creek at the Ernestville community about 2 miles above the limits of this study. Another sizable tributary is Granny Lewis Creek at Mile 4.22 at the upper limits of this study.

In the reach covered by this report the stream falls from elevation 1,767 feet to 1,626 feet at an average rate of 33 feet per mile with a relatively uniform slope. The flood plain varies in width from 300 to 1,900 feet, with the narrowest sections in the bend around River Hill between Miles 2.0 and 1.4. The widest section is near the upper limits of the study at Mile 3.9. The lower 1.3 miles of the creek are in the flood plain of the Nolichucky River. Pertinent drainage areas of South Indian Creek are given in Table 4.

TABLE 4

DRAINAGE AREAS IN WATERSHED OF SOUTH INDIAN CREEK

Stream	Location	Mile above Mouth	Drainage Area sq. mi.
South Indian Creek	Mouth	0.0	81.0
	Bridge near River Hill	1.38	80.2
	Bridge at Shallowford Church	3.14	76.9
	Below Granny Lewis Creek (upper limit of study)	4.22	72.5

III.

THE FLOOD PLAINS

Along the streams covered by this report, there are many man-made features which may be affected by floods or which may have an effect upon the height of floodwaters. This section of the report discusses the industrial, commercial, and residential developments in the flood plains, the highways and railroads that parallel the streams or cross the flood plains, and the bridges and dams spanning the streams.

1. NOLICHUCKY RIVER

Developments in the Flood Plain

Plate 7 is a map showing the flood plain of the Nolichucky River for the reach covered by this report. Except for the railroad and highway locations, there are few developments on the flood plain, which is primarily in agricultural use.

The Clinchfield Railroad parallels the river from its head in North Carolina to Erwin. Much of that reach is in a gorge with the downstream end at Unaka Springs, the upper limit of this study. There the railroad crosses the river and follows the right bank to Erwin, with a low point near the mouth of Martin Creek at elevation 1,644 feet, or about the level of the Maximum Probable Flood. In the gorge upstream from Erwin the floods of 1901, 1916, and 1940 damaged the railroad. A Regional Flood would result in similar damage, and the Maximum Probable Flood would cause greater damage since it would exceed the 1901 flood by several feet.

One major highway, U. S. Highway 19W & 23, crosses the flood plain of the Nolichucky River at Erwin. On the left bank of the river the highway roughly parallels the river for a distance of about 1 mile on a fill which is 3 to 8 feet high. A short section of this highway would be overtopped by a flood as large as that of 1940, and longer sections would be overtopped by a Regional Flood or a recurrence of the 1901 flood. A Maximum Probable Flood would inundate the entire mile of highway on the left bank, with depths of flooding up to 8 feet. The

old highway crossing located 1. 5 miles upstream is above the level of past floods, but is several feet below the Maximum Probable Flood.

Tennessee Highway 81 follows the right bank of the river downstream from the mouth of North Indian Creek. At the lower limits of this study reach it would be inundated by a Regional Flood or a recurrence of the 1901 flood, and during a Maximum Probable Flood it would be under 10 feet or more of water. A county road which follows the left bank through much of this study reach would be inundated by floods considerably lower than that of 1940.

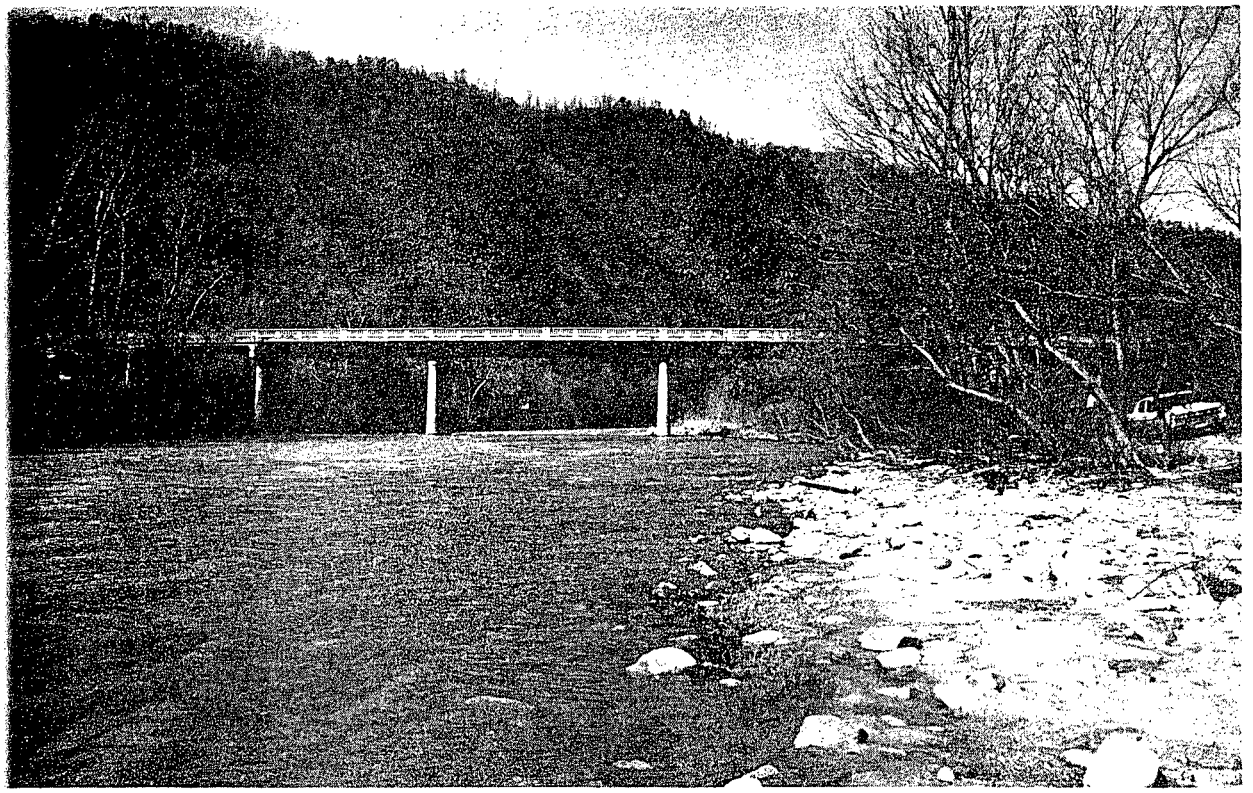
Most of the development along the Nolichucky River in the vicinity of Erwin is in the 2-mile reach extending upstream from the mouth of South Indian Creek. In the Riverview section most of the homes are above the level of the 1940 flood. A few would be flooded by a Regional Flood, others by the recurrence of the 1901 flood, and more than 30 homes would be flooded by a Maximum Probable Flood, with depths of flooding up to 12 feet. A flood as large as that of 1901 would be almost 2 feet deep in the county garage on the right bank and 1 foot deep in the Belle grocery on the left bank. A Maximum Probable Flood would be almost 10 feet deep in these buildings and would be 6 feet above the floor of the Riverview Free Will Baptist Church.

Between the Riverview section and the old highway bridge upstream, there are about one dozen homes and the transmitter of radio station WEMB which are subject to flooding by the Maximum Probable Flood.

Downstream from the Riverview section near the mouth of Martin Creek are located the buildings of Nuclear Fuel Services, Inc. They are above the level of the Regional Flood but are 3 to 6 feet below the Maximum Probable Flood.

Bridges across the Stream

Two highway bridges and a railroad bridge cross the river within the limits of this study. Table 5 lists pertinent elevations for the bridges and shows their relation to the crest of the May 1901 flood and the Regional Flood. Plate 11 shows the relation of the floor and underclearance at the bridges to the flood profiles for the reach. Figures 1 and 2 show photographs of the bridges.



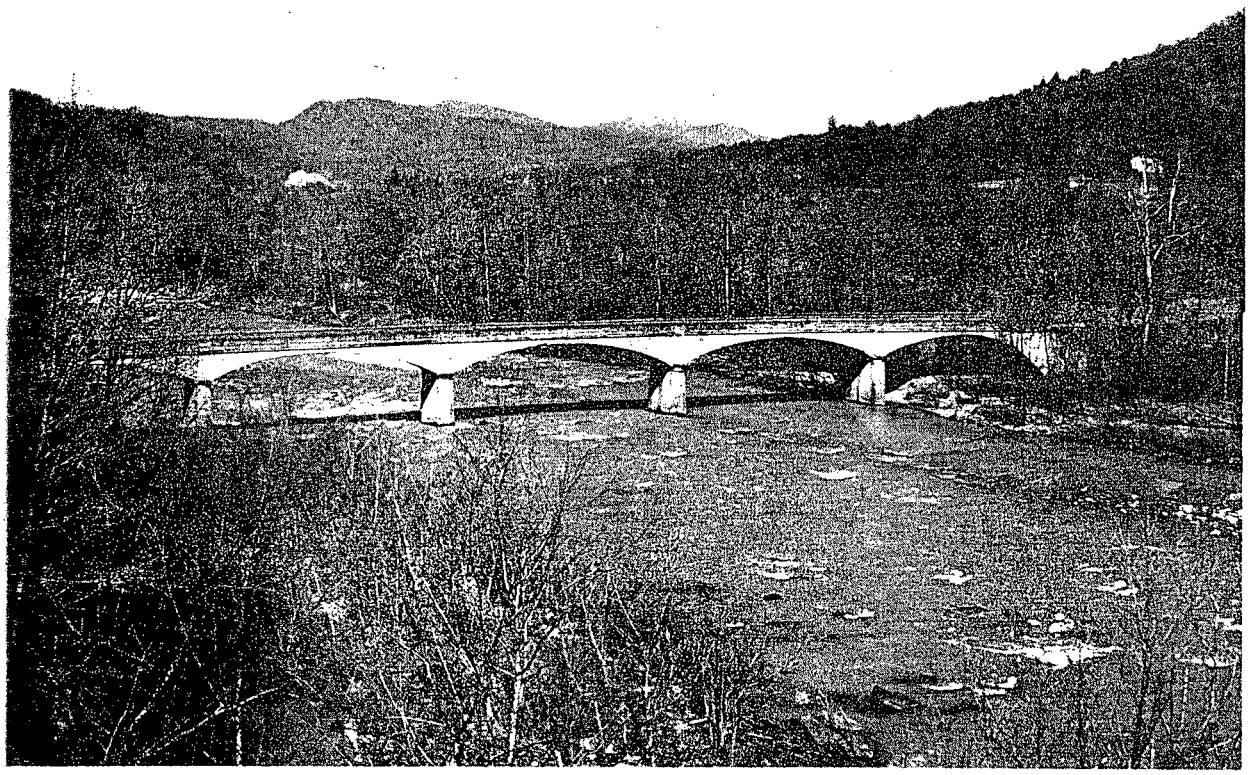


Figure 1. --HIGHWAY BRIDGES OVER NOLICHUCKY RIVER

Upper view is downstream toward the U. S. Highway 19W & 23 bridge at Mile 95.90. Lower view is downstream toward the bridge at Chestoa, Mile 97.37, which formerly carried the same two routes.

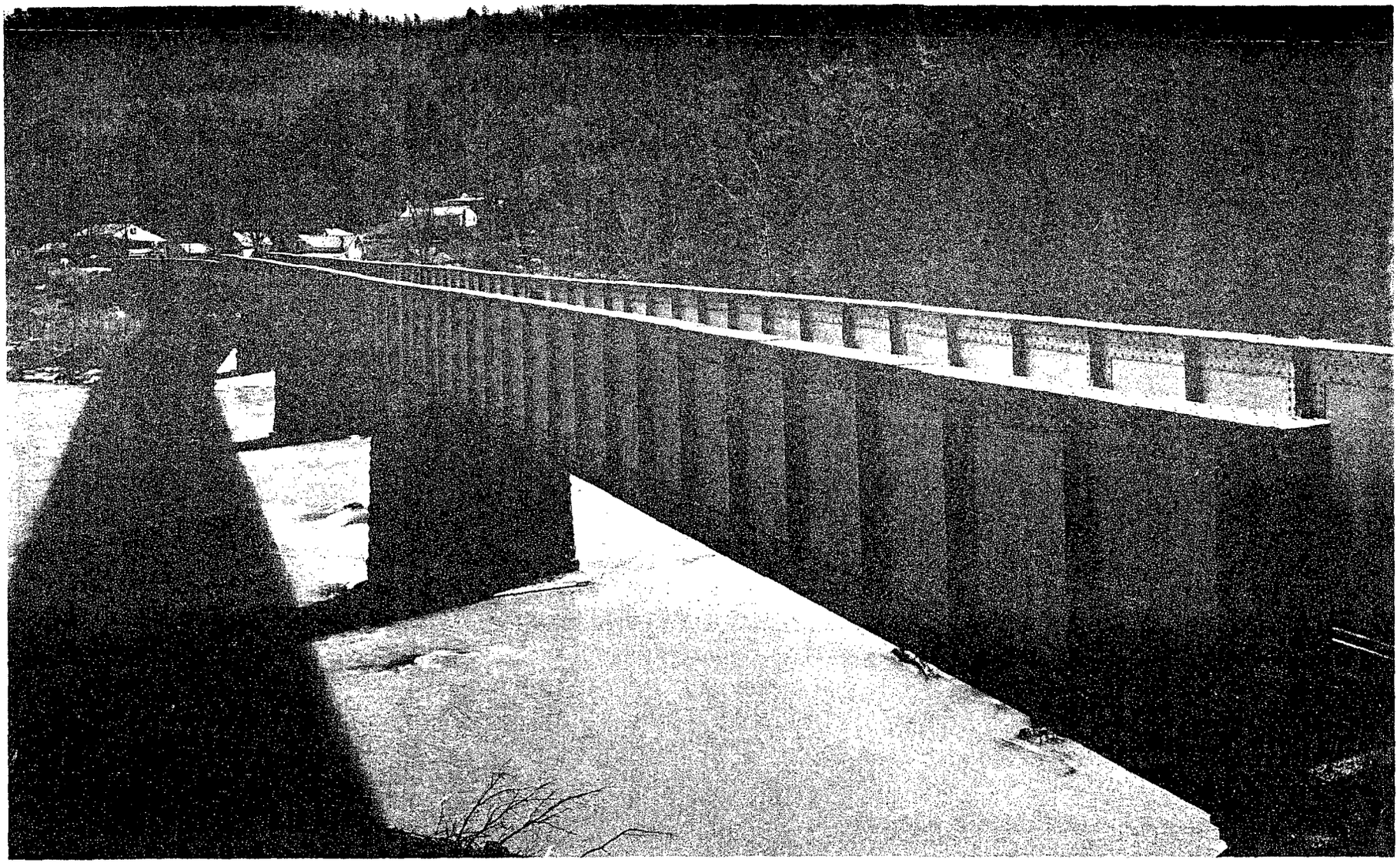


Figure 2. --CLINCHFIELD RAILROAD BRIDGE OVER NOLICHUCKY RIVER

The bridge is at Mile 98.00, and is seen here from the right end toward the community of Unaka Springs.

TABLE 5

BRIDGES ACROSS NOLICHUCKY RIVER

Mile above Mouth	Identification	Low Water Elev. feet	Floor Elev. feet	Regional Flood Crest Elev. feet	May 1901 Flood Crest Elev. feet	Underclearance Elev. feet	Underclearance Above 1901 Flood feet
95.90	U. S. Highway 19W & 23	1631.1	1664.6	1654.0	1654.2	1659.8	5.6
97.37	Old U. S. Highway 19W & 23	1658.0	1685.6	1680.5	1682.3	1683.0	0.7
98.00	Clinchfield Railroad	1676.9	1705.6*	1695.5	1696.7	1702.6	5.9

*Top of rail.

There has been no appreciable heading up during past floods at any of the bridges although there are small approach fills at both ends of the railroad and old highway bridges, and the new highway bridge has a long approach fill on the left end. At Unaka Springs, at the upper end of this study, the Clinchfield Railroad bridge has an underclearance above the level of past floods and the Regional Flood; however, it would be overtopped by the Maximum Probable Flood, and heading up of about 3 feet would occur.

Both the old and new U. S. Highway 19W & 23 bridges are above the level of past floods and the Regional Flood, but they too would be overtopped by the Maximum Probable Flood. At the old concrete arch bridge, heading up would amount to 10 feet, and at the new bridge the long fill would result in heading up of about 4 feet.

Obstructions to Flood Flow

The effect of obstructions due to the bridges and their approach fills has been described in the previous section. With the exception of the bridges, there are no significant obstructions to flows in the Nolichucky River reach included in this study.

...he bridge is at Mile 98.00, and is seen here from th...ht end toward the community of Unaka Springs.

2. NORTH INDIAN CREEK

Developments in the Flood Plain

Plates 8 and 9 are maps showing the flood plain of North Indian Creek for the reach covered by this investigation. There is considerable development in the flood plain in the vicinity of Erwin and 5 miles upstream at Unicoi.

The Clinchfield Railroad shops and yards are located on the left bank of the creek near its mouth, but the tracks and lowest buildings are above the level of the Maximum Probable Flood. The main line of the railroad follows the left bank of North Indian Creek upstream to Unicoi where it crosses the stream and continues north out of the watershed. The tracks are above flood level for most of this distance, but in the vicinity of Tennessee Highway 81 at Mile 1.2 the tracks on a siding dip to an elevation about 1 foot below the level of the Regional Flood and 2 feet below the Maximum Probable Flood. At Unicoi, the tracks cross the flood plain of the creek on a high fill which would be overtopped by more than 1 foot during a Regional Flood and about 3 feet during a Maximum Probable Flood.

Tennessee Highway 81 crosses the North Indian Creek flood plain at its widest part, and a one-half-mile stretch of the highway is subject to flooding with depths up to 6 feet during a Regional Flood and 7 feet during a Maximum Probable Flood.

U. S. Highway 19W & 23 roughly parallels North Indian Creek between Erwin and Unicoi. It is out of the flood plain except at Unicoi where it crosses at an elevation 5 feet lower than the Regional Flood and 7 feet lower than the Maximum Probable Flood. Tennessee Highway 107 follows the right bank of the creek upstream from Unicoi. Regional or Maximum Probable Floods would inundate the highway in the one-half-mile section upstream from the intersection with U. S. Highway 19W & 23, and also in some short sections farther upstream. Numerous county roads and streets are subject to flooding in the vicinity of Erwin and Unicoi, and in the Rock Creek and Fishery communities.

The Erwin sewage treatment plant at Mile 0.4 had water in the edge of the yard in March 1965. Regional and Maximum Probable Floods would be 4 and 7 feet higher, respectively, but would not reach critical elevations at the plant.

The Vulcan Materials Company has offices, crushers, and separators in the flood plain at Mile 0.7. This company is affected by even the small floods as it mines the sand and gravel from the mouth to Mile 1.8 along both sides of the creek. The laboratory floor is 2 and 3 feet, respectively, below the Regional and Maximum Probable Floods.

The floor of the Hoover Ball and Bearing Company plant located on the left bank downstream from Tennessee Highway 81 is 1 foot lower than the Regional Flood and over 2 feet lower than the Maximum Probable Flood.

On the upstream side of Tennessee Highway 81 the Armstrong Glass Company is building a new plant on the left bank. The floor is above the level of the Maximum Probable Flood.

On the right bank in the Willow Park area above and below Tennessee Highway 81, there are a large number of homes in the flood plain between Miles 0.9 and 1.8. Some of these homes have been flooded by past floods, and many would be flooded by Regional and Maximum Probable Floods with depths ranging up to 7 feet. The five businesses and two churches in this area would also be affected by such floods.

In the Rock Creek community, between Miles 1.8 and 2.8, three homes on the right bank were flooded in March 1965. In the event of a Regional Flood more than 50 homes and two businesses would be flooded with depths up to 8 feet. A Maximum Probable Flood would be about 3 feet higher. In the Fishery community, Mile 2.8 to 3.8, three homes were flooded in March 1965. Almost 50 homes on the left bank and several on the right bank would be flooded with depths ranging up to 7 feet during a Regional Flood and 10 feet during a Maximum Probable Flood. Other homes on the side of the mountain on the right bank in this area would be isolated because all access roads would be inundated by such floods. The Fishery Elementary School would be surrounded by water during a Regional or Maximum Probable Flood, but the floor is slightly higher than the latter flood.

From the Fishery community to Unicoi the flood plain is mostly in agricultural use with only scattered homes. Approximately 20 homes in this area would be affected by a Maximum Probable Flood.

At Unicoi, most of the homes and commercial buildings are above the 1965 flood; but in the event of a Regional or Maximum Probable Flood about 100 homes, five businesses, three churches, the post office, and a state highway garage would be flooded. Depths of flooding during a Regional Flood would range up to 6 feet except at a sawmill located just downstream from U. S. Highway 19W & 23 which would be flooded to a depth of about 10 feet. A Maximum Probable Flood on North Indian Creek would exceed the Regional Flood by about 1.5 feet in the vicinity of Unicoi. The ground at the Unicoi Elementary School is at the level of the Regional Flood, but the floor is above the Maximum Probable Flood. The post office would be flooded to a depth of 4 feet by the latter flood.

In the reach above Unicoi, only scattered homes dot the narrowing flood plain. None of these was flooded in 1965, but several would be inundated during a Regional or Maximum Probable Flood.

The Johnson City water treatment plant at Mile 7.96 has a basement floor elevation of 2016.6 and pumphouse floor elevation of 2015.4. The Regional Flood elevation at that location is 2016.3, and the Maximum Probable Flood is 1.9 feet higher.

Channel Changes

Sand and gravel operations near the mouth of North Indian Creek have made many changes in the channel from the mouth to Mile 1.8. Mining of the gravel in the flood plain began in 1940 on the right bank in the lower 0.8 mile of the creek. Later operations moved upstream from Tennessee Highway 81 between Miles 1.3 and 1.7 where the creek bed has been lowered as much as 10 feet. In recent months the mining operations have again moved downstream, and at Mile 0.7 the creek has been diverted from its original bed to a large pond on the right bank from which it flows into the Nolichucky River at Mile 94.1, 0.1 mile downstream from the original mouth of the creek. The original bed and left-bank flood plain are now being excavated for sand and gravel from the mouth to Mile 0.5.

Bridges across the Creek

Fifteen road or highway bridges, one railroad bridge, and two footbridges cross North Indian Creek in the reach covered by this investigation.

Table 6 lists pertinent elevations for the bridges and shows their relation to the crest of the flood of March 1965 and the Regional Flood. Plate 11 shows the relation of the floor and underclearance of the bridges to the flood profiles for the reach. Figures 3 and 4 show photographs of some of the bridges on North Indian Creek.

TABLE 6

BRIDGES ACROSS NORTH INDIAN CREEK

Mile above Mouth	Identification	Low Water Elev. feet	Floor Elev. feet	Regional Flood Crest Elev. feet	March 1965 Flood Crest Elev. feet	Underclearance Elev. feet	Underclearance Above 1965 Flood feet	Underclearance Below 1965 Flood feet
0.72	Private road	1637.4	1643.0	1643.6	1642.2	1641.0		1.2
0.90	Footbridge	1638.7	1645.4	1650.0	1645.2	1644.4		0.8
1.22	Tennessee Highway 81	1645.1	1662.5	1664.0	1652.1	1660.3	8.2	
2.28	County road	1700.1	1708.4	1712.2	1704.5	1707.2	2.7	
2.34	County road	1703.6	1710.3	1714.5	1707.2	1709.0	1.8	
2.49	County road	1707.5	1714.6	1720.4	1712.5	1713.3	0.8	
2.87	County road	1722.0	1729.9	1734.7	1728.2	1728.6	0.4	
3.19	Footbridge	1734.0	1740.4	1747.8	1740.3	1739.4		0.9
3.30	County road	1739.1	1746.5	1752.1	1744.6	1745.4	0.8	
4.78	Private road	1804.3	1811.6	1813.5	1809.5	1810.0	0.5	
5.08	Private road	1814.8	1823.0	1826.9	1820.1	1821.7	1.6	
5.38	Private road	1834.6	1840.1	1847.0	1839.7	1838.9		0.8
6.61	Old U. S. Highway 19W & 23	1906.4	1919.4	1918.5	1909.6	1916.9	7.3	
6.72	Clinchfield Railroad	1911.5	1930.1*	1931.4	1916.3	1920.6	4.3	
6.75	U. S. Highway 19W & 23	1913.0	1925.8	1931.5	1918.2	1922.4	4.2	
7.54	County road	1972.7	1978.7	1983.5	1974.8	1977.3	2.5	
8.85	Private road	2059.7	2067.8	2082.4	2066.4	2067.0	0.6	
9.19	Private road	2099.2	2106.8	2113.9	2103.0	2105.3	2.3	

*Top of rail.

Twelve of the bridges on North Indian Creek are private and county bridges of wood or concrete construction with small approach fills. All of these bridges and the two footbridges would be overtopped by a Regional Flood and heading up would be negligible except at the Mile 8.85 bridge which is located in a naturally restricted channel section. At that bridge, heading up of about 5 feet would occur during large floods.

At Mile 1.22 Tennessee Highway 81 crosses the creek on a concrete bridge with a relatively large opening and low approach fills. The bridge would be overtopped during a Regional Flood and heading up of about 2 feet would occur.

The old U. S. Highway 19W & 23 bridge at Mile 6.61 in Unicoi is of concrete arch design and has low approach fills. A Regional Flood would inundate the right-bank approach by more than 7 feet. A Maximum Probable Flood would be almost 2 feet higher and would overtop the bridge floor. During such floods heading up would be about 1 foot.

The Clinchfield Railroad bridge in Unicoi at Mile 6.72 has long, high approach fills and a small opening which restricts high flows to the extent that heading up of almost 10 feet would occur during Regional or Maximum Probable Floods.

U. S. Highway 19W & 23 bridge at Mile 6.75 in Unicoi is a concrete structure with approach fills that under normal conditions would restrict high flows and result in some heading up. However, heading up would be negligible during Regional or Maximum Probable Floods because of the great heading up at the railroad bridge just downstream. During a Regional Flood, the water backed up above the railroad bridge would be 5 feet higher than the floor of the highway bridge.

Dams across North Indian Creek

At the Johnson City water treatment plant at Mile 7.96 there is a small concrete dam about $3\frac{1}{2}$ feet high. The dam is not high enough to affect flood flows. Another low dam is located at Mile 2.10. It has been practically demolished and has no effect upon the height of flood flows.

Obstructions to Flood Flow

The effect of obstructions due to the bridges and their approach fills and to the dams has been described in the previous sections. The changes in the channel and flood plain due to the removal of sand and gravel in the reach from the mouth upstream to Mile 1.8 will affect future flood heights. In the reaches where the channel is enlarged or deepened, flood heights will be lowered.

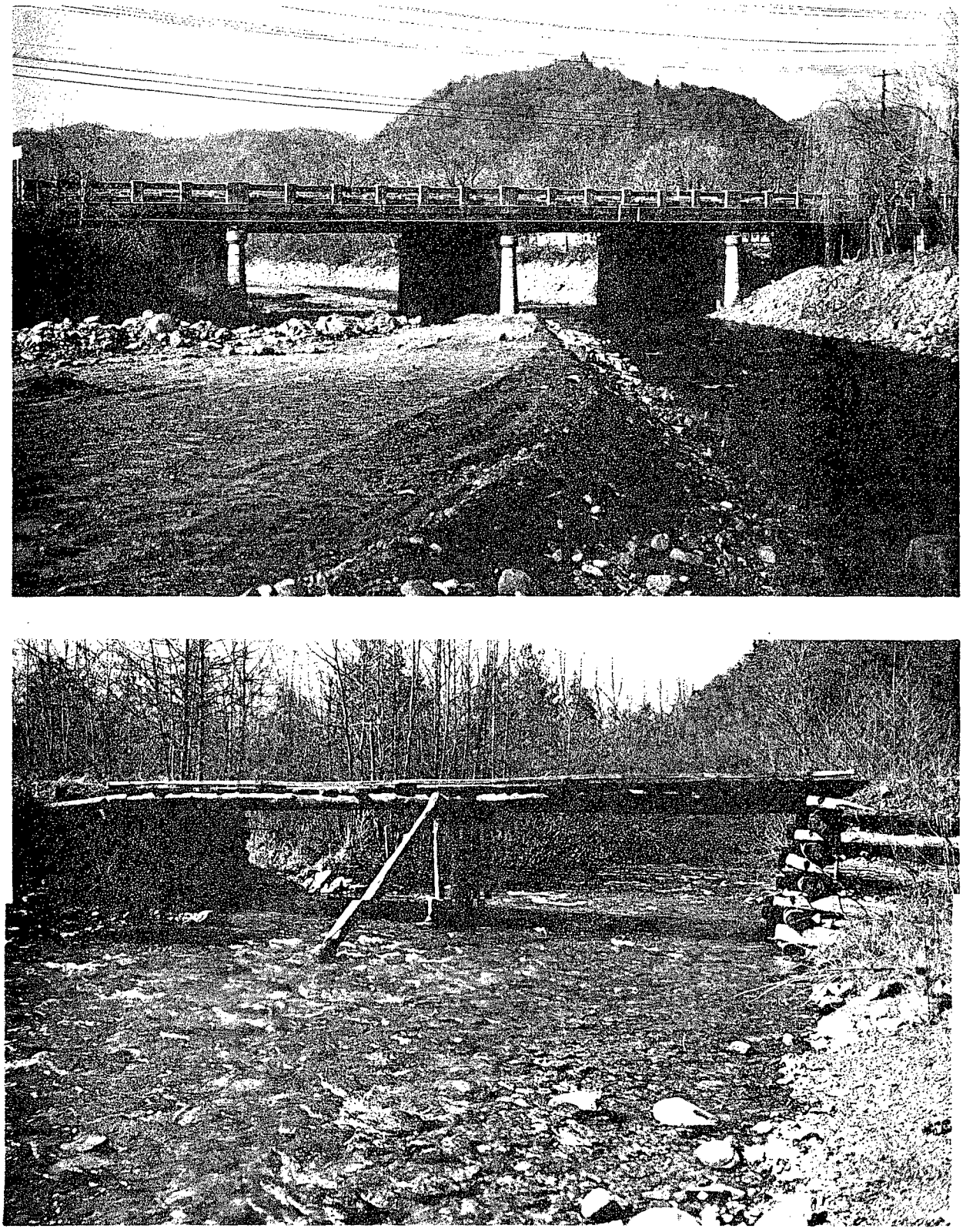


Figure 3. --NORTH INDIAN CREEK BRIDGES NEAR ERWIN

Upper view is the upstream side of the Tennessee Highway 81 bridge at Mile 1.22, near the upper end of the railroad yards. Lower view is typical of several county bridges along the stream and shows the downstream side of the structure at Mile 5.08, a half mile north of Dry Creek.

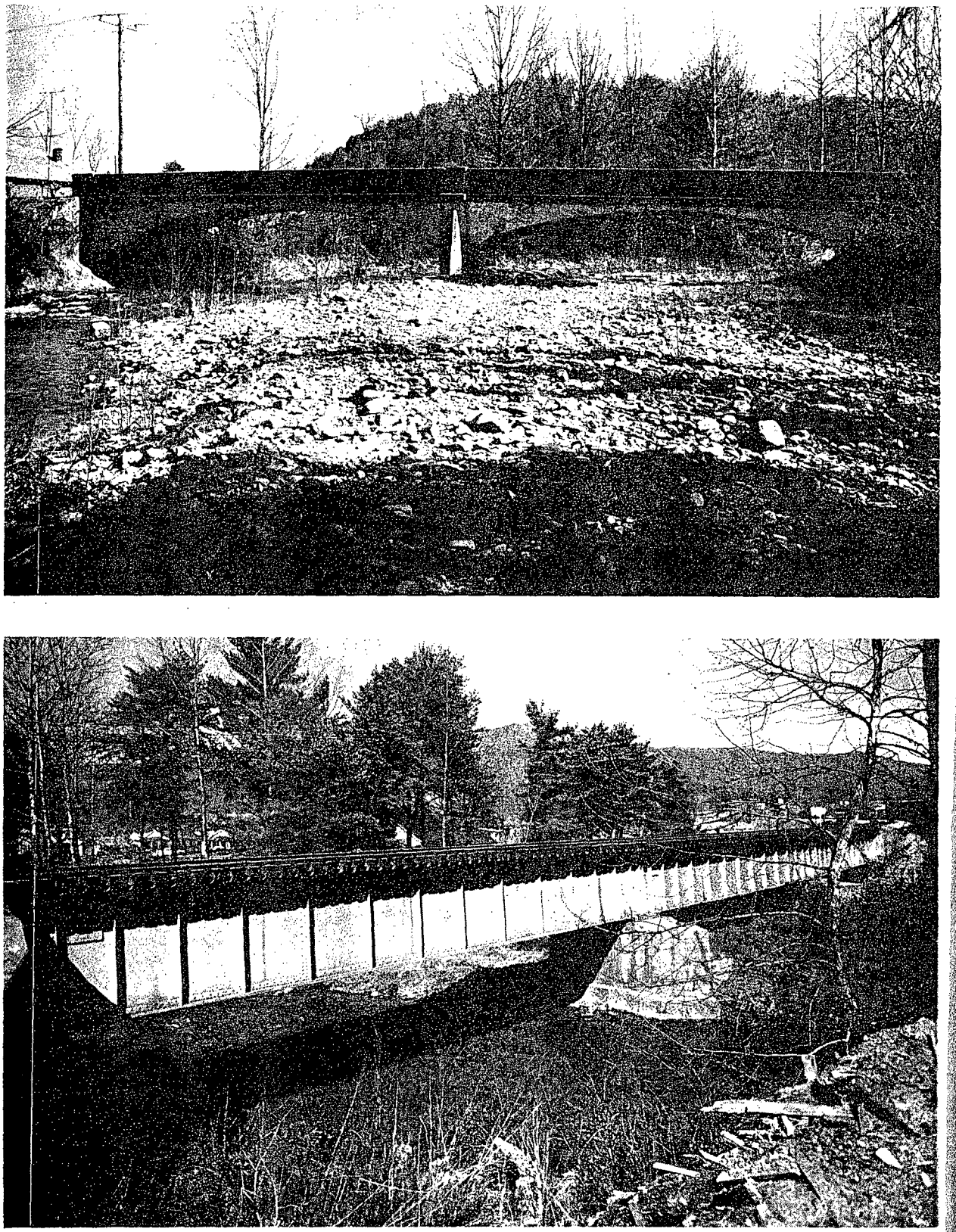


Figure 4. --NORTH INDIAN CREEK BRIDGES AT UNICOI

Upper view is the downstream side of the old U. S. Highway 19W & 23 bridge at Mile 6.61. Lower view is the upstream side of the Clinchfield Railroad bridge at Mile 6.72, taken from the new U. S. Highway 19W & 23.

3. SOUTH INDIAN CREEK

Developments in the Flood Plain

Plate 10 is a map showing the flood plain of South Indian Creek for the reach covered by this report. The flood plain is primarily in agricultural use, but there are some other developments.

U. S. Highway 19W & 23 roughly parallels the creek through the reach and is on a fill in the flood plain from Mile 0.3 to Mile 1.1, and from Mile 2.8 to the upper limits of the study. The highway is slightly lower than the Regional Flood on South Indian Creek for about 1,000 feet downstream from Mile 1.0. It is below the Maximum Probable Flood by as much as 4 feet between Miles 0.4 and 1.1, and by about 2 feet between Miles 3.0 and 3.9. Several county roads in the flood plain were flooded in March 1965.

That portion of the Riverview section which is on the left bank of the Nolichucky River is also subject to flooding by South Indian Creek. Several residences and the Belle grocery would be flooded with depths up to 3 feet during a Regional Flood and 9 feet during a Maximum Probable Flood. In the vicinity of Mile 1.0 some new homes along U. S. Highway 19W & 23 are subject to flooding by the Maximum Probable Flood. Several other residences along the creek between Mile 1.0 and the upper limit of the study would be flooded with depths up to 5 feet during a Regional Flood and up to 8 feet during a Maximum Probable Flood.

The floor of the Moore Electric Company building at Mile 2.77 is above the Regional Flood, but is 1 foot below the Maximum Probable Flood. At Mile 3.23, Simmon's sawmill is 4 feet lower than the Regional Flood, as is the floor of Moore's Motel at Mile 3.87. The Maximum Probable Flood would exceed the Regional Flood by about 2 feet at these locations. The Temple Hill School, at the upper limits of the study, is above the level of the Maximum Probable Flood.

Bridges across the Creek

Four county roads cross South Indian Creek in the reach covered by this investigation. Table 7 lists pertinent elevations for the bridges and shows

their relation to the crest of the flood of March 1965 and to the Regional Flood. Plate 11 shows the relation of the floor and underclearance at the bridges to the flood profiles for the reach. Figure 5 shows photographs of two of the bridges on South Indian Creek.

These are all small wooden bridges setting at the top of the bank so there are no approach fills. Heading up would be negligible except at the bridge at Mile 1.38 which is located in a naturally restricted section. At that bridge, heading up would amount to about 5 feet during large floods.

TABLE 7

BRIDGES ACROSS SOUTH INDIAN CREEK

Mile above Mouth	Identification	Low Water Elev. feet	Floor Elev. feet	Regional Flood Crest Elev. feet	Mar. 1965 Flood Crest Elev. feet	Underclearance Elev. feet	Above 1965 Flood feet	Below 1965 Flood feet
0.34	County road	1639.4	1644.8	1655.0	1646.9	1643.4		3.5
1.38	County road	1668.1	1680.0	1689.1	1676.7	1678.6	1.9	
3.14	County road	1725.2	1733.2	1737.5	1732.5	1731.8		0.7
3.73	County road	1746.8	1757.0	1758.3	1754.9	1755.7	0.8	

Obstructions to Flood Flow

The effect of obstructions due to the bridges and their approach fills has been described in the previous section.

The fills on U. S. Highway 19W & 23 on the right bank of South Indian Creek would have a minor effect upon flood height, but there are no significant obstructions to flows in the reach included in this study.

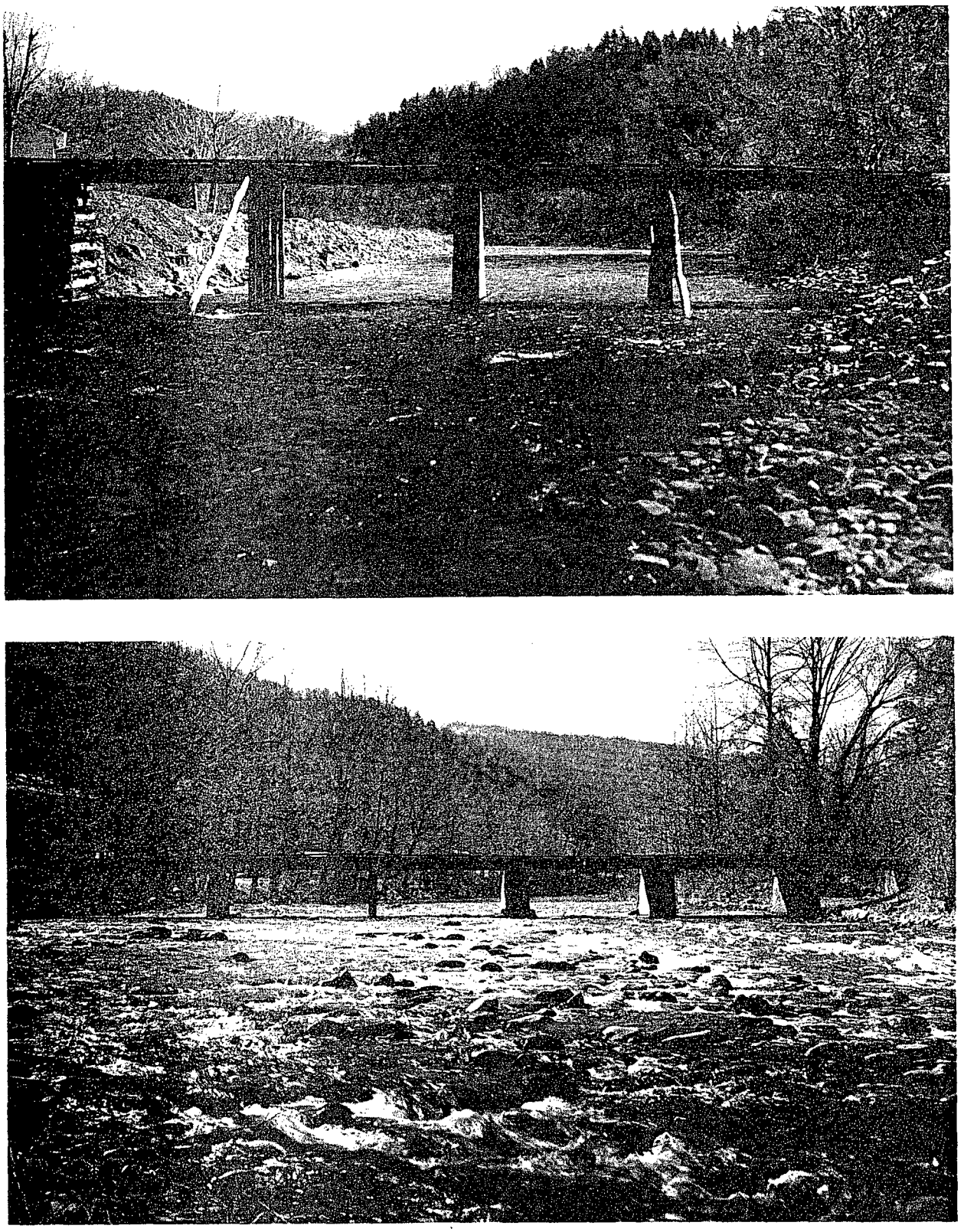


Figure 5. --SOUTH INDIAN CREEK BRIDGES

The county bridge at Mile 1.38, shown in upper view, replaced a timber crib structure washed out by the March 1963 flood as shown in Figure 7. The view is upstream. The lower view, also upstream, shows the county bridge at Mile 3.14, opposite Shallowford Church.

IV.

PAST FLOODS[1]

This section of the report is a history of floods which have occurred on Nolichucky River, North Indian Creek, and South Indian Creek in the vicinity of Erwin in Unicoi County, Tennessee. The portion of the Nolichucky River considered extends from the Unicoi-Washington County line at Mile 92.7 upstream to Mile 98.3 at Unaka Springs. The investigation on North Indian Creek covers the 9.4 miles from its confluence with the Nolichucky River at Erwin to the mouth of Dick Creek upstream from Unicoi. South Indian Creek is covered for the 4.2 miles from the mouth in Nolichucky River near Erwin to the mouth of Granny Lewis Creek.

Records of river stages and discharges are available on Nolichucky River at Embreeville, 3.7 miles downstream from the Unicoi-Washington County line, since July 1920. Records are also available for the years from 1903 to 1926 and from 1945 to date from various gages on the Nolichucky River in the vicinity of Greeneville, about 40 miles downstream from Embreeville. On North Indian Creek a recording stream gage was operated from May 1944 to September 1957 at a site near Unicoi, 10.8 miles above the mouth. A crest-stage partial-record station has been maintained at the site with few interruptions since October 1958. No records of stages and discharges are available for South Indian Creek.

A flood history investigation was made on Nolichucky River in 1938 and further investigations were made following the flood of August 14, 1940. In 1948 an investigation was made on North Indian Creek which covered only the 1.5-mile reach centered at the Tennessee Highway 81 bridge in Erwin. After the flood of March 1965, detailed profiles were developed for the reaches of North and South Indian Creeks covered by this report.

This section of the report discusses separately the flood history of Nolichucky River, North Indian Creek, and South Indian Creek.

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1. Prepared by Hydraulic Data Branch.

1. NOLICHUCKY RIVER

Flood Records

On September 5, 1900, the U. S. Geological Survey installed a chain gage on a bridge crossing the Nolichucky River about 2 miles downstream from Embreeville. The great flood of May 1901 washed out the bridge and gage. The next gage was also a chain gage installed in May 1903 on a bridge near Greeneville, over 30 miles downstream from the first gage. Daily observations were made through December 1908, and again at this site from April 1919 through September 1925. The first gage at Embreeville was a chain gage established on Tennessee Highway 81 bridge in July 1920. It was replaced by a recorder located 2,000 feet upstream in September 1931. During the period from December 1906 to February 1926 the U. S. Weather Bureau made daily observations on staff gages near Greeneville.

The following tabulation of gage data on the Nolichucky River in the reach between Miles 45.7 and 89.1 shows that records are available from one or more gages for the entire period from May 1903 to date, with the additional short period in 1900 and 1901.

Station	Type	Agency	River Mile	Drainage Area sq. mi.	Period of Record
Near Chucky Valley	Chain	USGS	86.7	817	9/5/00 - 5/21/01
Near Greeneville	Chain	USGS	54.1	1141	5/9/03 - 12/31/08
	Chain	USGS	54.1	1141	4/17/19 - 9/30/25
At Birds Bridge	Staff	USWB	50.3	1151	12/1/06 - 12/31/15
Near Greeneville	Staff	USWB	45.7	1184	1/1/16 - 2/3/26
At Embreeville	Chain	USGS	88.6	805	7/1/20 - 6/30/32
	Recorder	USGS	89.1	805	10/1/31 - date
Below Nolichucky Dam	Recorder	USGS	45.7	1184	10/1/45 - date

To supplement the records obtained at these gaging stations, local residents were interviewed for information on dates and heights of floods. Newspaper files were searched, as were historical documents and records, which included files in the office of the Chief Engineer of the Clinchfield Railroad. Valuable data were obtained from reports of field investigations made by TVA

engineers after the flood of August 1940. These records and investigations have developed a knowledge of floods on Nolichucky River covering the past 100 years or more.

Flood Stages and Discharges

Table 8 lists peak stages and discharges for the known floods exceeding the bankfull stage of 7 feet at the U. S. Geological Survey gaging station on Nolichucky River at Embreeville. Stages for floods occurring prior to 1920 are from high water marks or are estimated upon the basis of correlations with downstream gages. Table 9 lists the highest 10 floods in order of magnitude at the Embreeville gage. In the vicinity of Erwin the order of magnitude would be about the same, although the 1902 flood probably exceeded the 1940 flood.

Flood Occurrences

Plate 2 shows known crest stages and months of occurrence of floods since 1867 which have exceeded the bankfull stage of 7 feet on Nolichucky River at the Embreeville stream gage. Table 10 shows the monthly distribution of the 50 floods occurring during the period of gage records since 1900. The record shows that floods have occurred in every month of the year. Floods on the Nolichucky River result from general heavy rain over the basin in the winter and spring months, or from thunderstorms or tropical hurricanes in the summer and fall months.

Duration and Rate of Rise

Plate 3 shows the stage hydrograph on Nolichucky River for the mid-August 1940 flood. During that flood the river rose to its crest stage in 11 hours at an average rate of 1. 2 feet per hour with a maximum rate of 4. 3 feet per hour, and remained above bankfull stage for 24 hours.

Velocities

During the flood of August 1940, it is estimated that velocities in the channel of Nolichucky River in the vicinity of Erwin ranged up to more than 15 feet per second. Overbank velocities ranged up to 5 feet per second. During larger floods, velocities would be even greater.

TABLE 8

FLOOD CREST ELEVATIONS AND DISCHARGES

NOLICHUCKY RIVER AT EMBREEVILLE, TENNESSEE

1867-1966

This table includes all known floods above bankfull stage of 7 feet at the U. S. Geological Survey stream gaging station on Nolichucky River at Embreeville, Tennessee, located at River Mile 89.06. Drainage area = 805 square miles. Zero of gage = 1519.30 feet.

Date of Crest	Gage Height		Peak Discharge	
	Stage feet	Elevation feet	Amount cfs	Per Sq. Mi. cfs
September 1824	(a)			
March 7, 1867	(a)			
February 1875	(a)			
March 1899	(a)			
October 23, 1900	7.8[b]	1527.1	21,800	27
April 3, 1901	7.3[b]	1526.6	19,000	24
May 21, 1901	24[c]	1543	120,000	149
February 28, 1902	18[c]	1537	80,000	99
July 12, 1905	8[b]	1527	23,000	29
January 23, 1906	15[b]	1534	60,000	75
November 19, 1906	12[b]	1531	43,000	53
January 12, 1908	7[b]	1526	18,000	22
May 21, 1909	(a)			
March 27, 1913	(a)			
October 16, 1914	(a)			
December 26, 1914	(a)			
July 16, 1916	17[c]	1536	75,000	93
October 26, 1918	(a)			
October 31, 1918	(a)			
April 2, 1920	11[b]	1530	38,000	47
August 3, 1921	8.6	1527.9	25,900	32
August 16, 1928	10.6	1529.9	35,300	44
October 22, 1929	7.8	1527.1	22,300	28
July 15, 1934	10.30	1529.60	35,000	43
January 8, 1935	10.28	1529.58	34,600	43

TABLE 8 (Continued)

Date of Crest	Gage Height		Peak Discharge	
	Stage feet	Elevation feet	Amount cfs	Per Sq. Mi. cfs
March 20, 1935	7.08	1526.38	18,500	23
March 26, 1935	10.69	1529.99	36,600	45
January 19, 1936	8.76	1528.06	28,700	36
April 6, 1936	7.46	1526.76	20,700	26
October 16, 1936	8.80	1528.10	28,700	36
April 20, 1940	7.34	1526.64	19,100	24
August 13, 1940	18.57	1537.87	82,500	102
August 30, 1940	11.25	1530.55	39,500	49
December 30, 1942	8.56	1527.86	25,700	32
January 8, 1946	9.20	1528.50	28,800	36
February 10, 1946	7.06	1526.36	18,100	22
January 20, 1947	7.65	1526.95	21,300	26
June 16, 1949	10.71	1530.01	36,900	46
August 29, 1949	9.41	1528.71	29,900	37
September 1, 1950	7.70	1527.00	21,100	26
December 7, 1950	8.96	1528.26	27,500	34
February 21, 1953	7.82	1527.12	21,800	27
January 22, 1954	9.20	1528.50	28,800	36
April 16, 1956	7.73	1527.03	21,200	26
February 1, 1957	8.72	1528.02	25,600	32
April 5, 1957	11.00	*1530.30*	*38,000*	*47*
January 22, 1959	7.46	1526.76	19,500	24
September 30, 1959	9.20	1528.50	28,100	35
December 12, 1961	7.82	1527.12	21,200	26
March 6, 1963	9.74	1529.04	31,000	38
March 12, 1963	12.76	1532.06	47,900	60
October 16, 1964	9.30	1528.60	28,700	36
March 26, 1965	11.59	1530.89	41,300	51
February 13, 1966	11.52	1530.82	40,900	51

(a) Stage unknown. Flood investigations indicate that floods occurred on these dates.
(b) From stages reported at gages near Chucky Valley or Greeneville.
(c) From high water marks.

TABLE 9

HIGHEST KNOWN FLOODS IN ORDER OF MAGNITUDE

NOLICHUCKY RIVER AT EMBREEVILLE, TENNESSEE

Order No.	Date of Crest	Gage Height		Estimated Peak Discharge
		Stage feet	Elevation feet	cfs
1	May 21, 1901	24	1543	120,000
2	August 13, 1940	18.57	1537.87	82,500
3	February 28, 1902	18	1537	80,000
4	July 16, 1916	17	1536	75,000
5	January 23, 1906	15	1534	60,000
6	March 12, 1963	12.76	1532.06	47,900
7	November 19, 1906	12	1531	43,000
8	March 26, 1965	11.59	1530.89	41,300
9	February 13, 1966	11.52	1530.82	40,900
10	August 30, 1940	11.25	1530.55	39,500

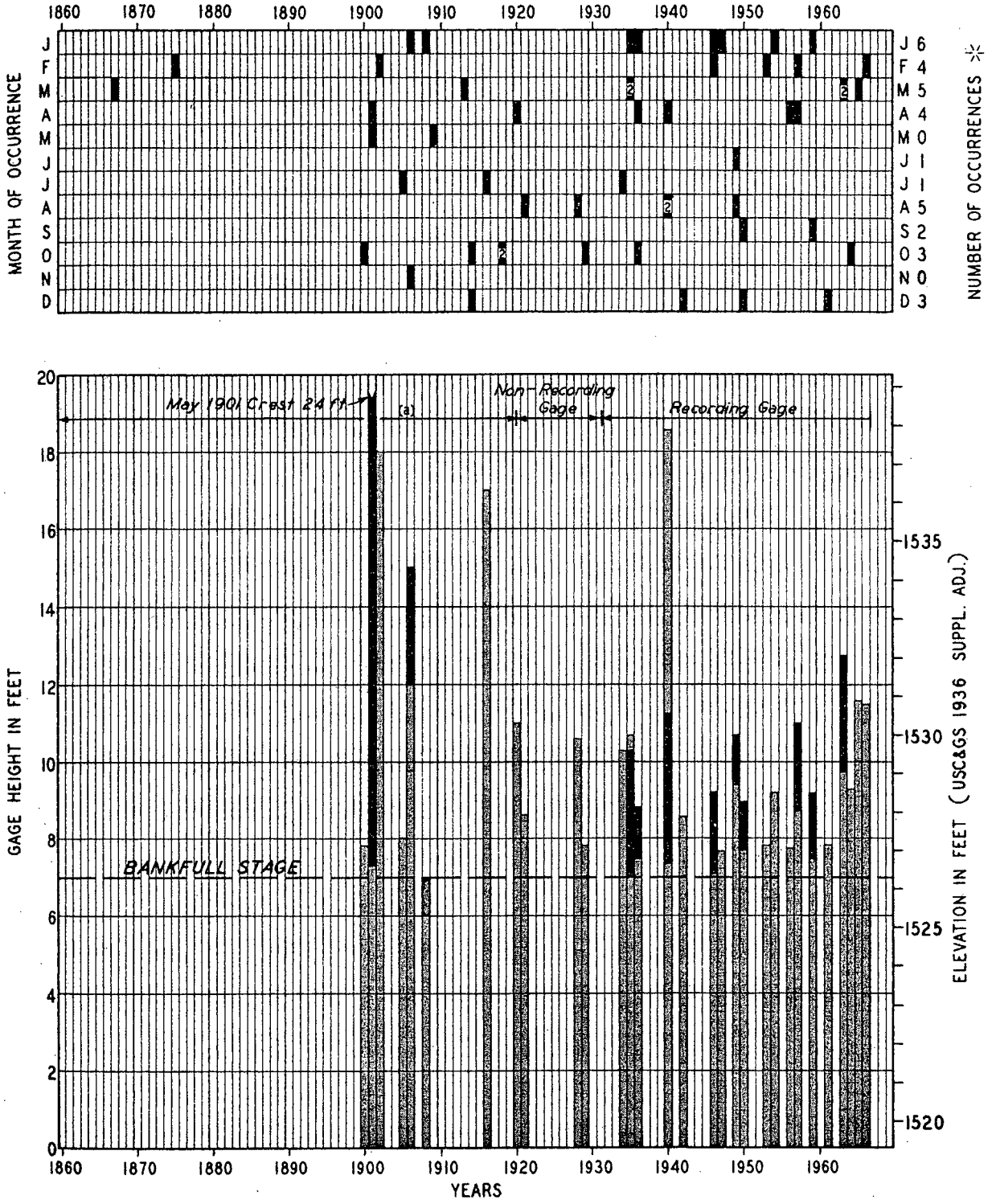
TABLE 10

MONTHLY FLOOD DISTRIBUTION*

NOLICHUCKY RIVER AT EMBREEVILLE, TENNESSEE

Month	Number of Occurrences	Month	Number of Occurrences
January	8	July	3
February	5	August	5
March	6	September	2
April	6	October	7
May	2	November	1
June	1	December	4
		Total	50

*Since 1900.



✳ Number of occurrences during 46 years of record July 1, 1920 through December 31, 1966

(a) Records of floods prior to July 1920 are incomplete. Flood heights shown during that period are based on high water marks and records at other stations.

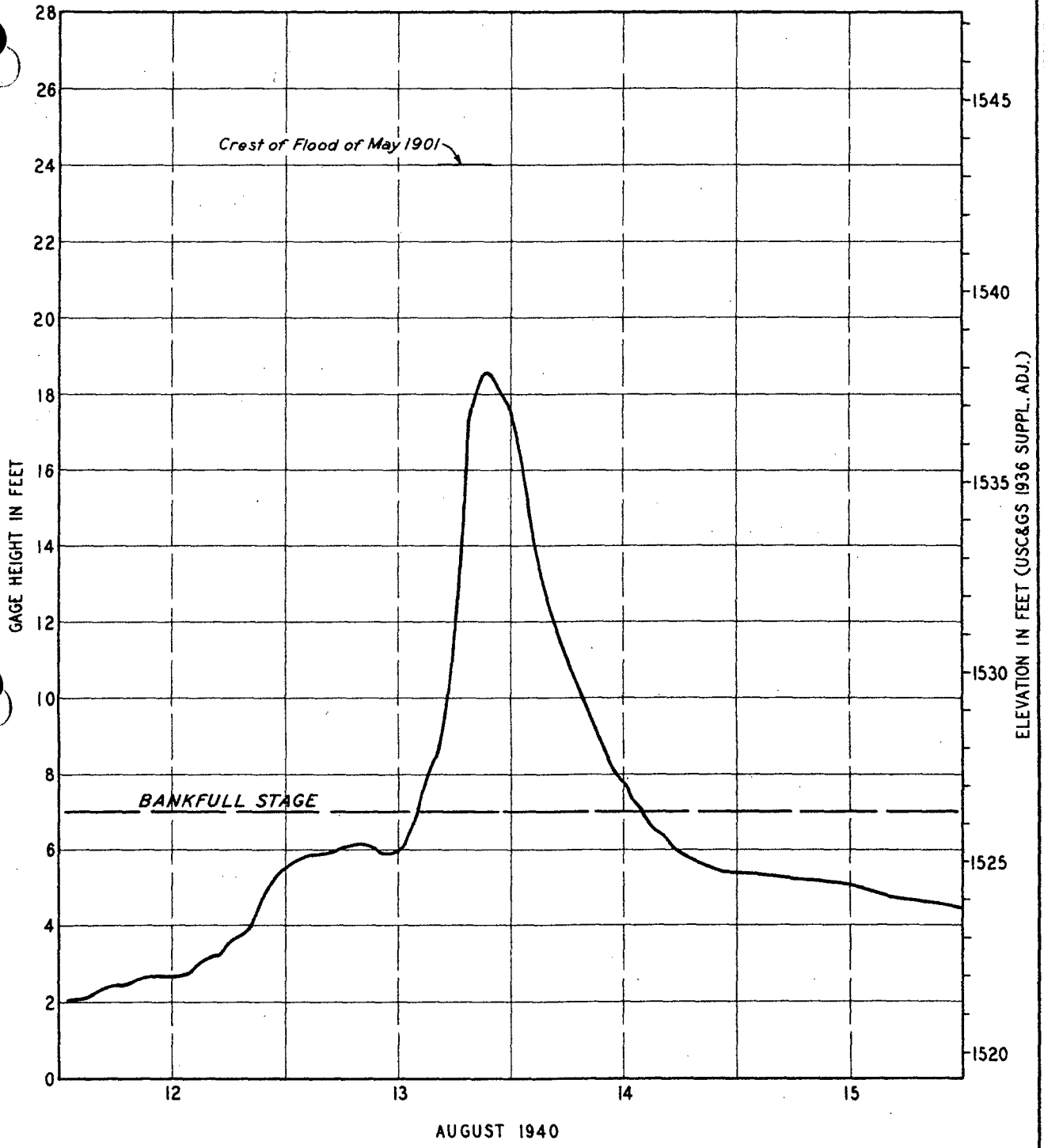
Stream gage at River Mile 89.06

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

FLOODS ABOVE BANKFULL STAGE NOLICHUCKY RIVER AT EMBREEVILLE, TENN.

MARCH 1967

PLATE 3



Stream Gage at
River Mile 89.06

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

STAGE HYDROGRAPH
NOLICHUCKY RIVER
AT
EMBREEVILLE, TENN.

MARCH 1967

Flooded Areas, Flood Profiles, and Cross Sections

Plate 7 shows the approximate area along Nolichucky River that was inundated by the flood of May 21, 1901, and that would be inundated by the Maximum Probable Flood. The actual limit of the overflow area on the ground may vary somewhat from that shown on the map because the contour interval of the map does not permit precise plotting of the flooded area boundaries. The contour interval on Plate 7 is 40 feet.

Plate 11 shows high water profiles on Nolichucky River for the floods of May 21, 1901, and August 13, 1940. Also shown are the profiles for the Regional and Maximum Probable Floods, which are discussed in Sections V and VI of this report.

Plate 12 shows typical cross sections of Nolichucky River in the reach investigated. The locations of the sections are shown on the map, Plate 7, and the profile, Plate 11. Each cross section shows the elevation and extent of overflow of the May 21, 1901, flood and the Regional and Maximum Probable Floods.

FLOOD DESCRIPTIONS

Following are descriptions of known large floods that have occurred on Nolichucky River and its tributaries. These are based upon newspaper accounts, historical records, and investigations by TVA engineers.

Early Floods

Information regarding floods on Nolichucky River prior to 1900 is limited. At Taylor Bridge, 3 miles downstream from Embreeville, Tennessee, it was said that at the time of the 1901 flood an old settler, Colonel William Bayliss, long since dead, remarked that in 1824 a flood of about the same height had occurred. Evidence was found to verify this statement in "The Knoxville Register" dated October 8, 1824, which stated:

> The accounts from the counties bordering on Nolichucky River are truly melancholy. The Greeneville Economist says the surface of the river was literally covered with property swept from owners. Trees were constantly prostrated by the force of the current. Almost every mill from the source to the mouth of the river was washed away or materially injured. After the water had fallen the body of a man that had been drowned was found in a drift some distance below Jonesboro. . . . . The river is said to have been 15 feet higher than it was ever known to be by the oldest inhabitants living on its borders.

No further information was found on the flood, but it was no doubt a large flood in the Erwin vicinity.

Great floods occurred throughout the upper half of the Tennessee Valley in March 1867. They were the largest floods ever known on the lower Holston, French Broad, and Little Tennessee Rivers and on the Tennessee River itself from Knoxville through Chattanooga.

In February 1875 the Tennessee River at Knoxville had the second highest known flood in its history. The Jonesboro, Tennessee, "Herald and Tribune" of March 4, 1875, reported that "the damage caused by the late freshets which have continued for the last nine days has been the principal topic with all. . . . The bridge over the Nola Chucky at the Red Banks was badly damaged, and will require several hundred dollars to repair it."

Floods were general throughout the upper Tennessee Valley during the latter half of March 1899. The Jonesboro "Herald and Tribune" of April 5, 1899, stated that "Chucky is still above its usual condition, having been thus for two weeks. Not since 1867 has it been so high as the recent tide."

Since the floods in 1867, 1875, and 1899 were general over the eastern part of the Valley, and since there are definite references to floods on the Nolichucky River, it is probable that floods occurred in the vicinity of Erwin in those years.

May 21, 1901

From Boonford, North Carolina, on the North Toe River to the mouth of the Nolichucky, this flood far exceeded any others known. The flood resulted from general rains over all the eastern edge of the Tennessee Basin since all streams are known to have been in flood. The most severe part of the storm

appears to have occurred over Mitchell County, North Carolina. On Cane Creek, a stream running through Bakersville in that county, a flood occurred which was probably the worst of any ever known in the area. In Engineering News of August 7, 1902, an article describes this flood. *

Destruction throughout the Nolichucky valley was said to have been severe with crop loss especially heavy in the rich bottom lands of the lower valley.

Near Chucky, Tennessee, three small children were swept away as their father attempted to rescue them. Further loss of life would surely have resulted had towns been built closer to the riverbank.

From the "Erwin Magnet" of Wednesday, May 29, 1901, the following is quoted:

> The damage to property in Unicoi County is great though no lives were lost.
>
> There were five dwelling houses at Unaka Springs with all furnishings washed away, and the dam and other works of General John T. Wilder were swept away.
>
> The railroad bridge at Unaka Springs was washed away as was also the county bridge.

The General Wilder dam referred to was a log crib structure about 14 feet high located just above the old U. S. Highway 19W & 23 bridge at Chestoa, near Erwin, which created a mill pond for the retention of logs which were worked up by a sawmill. During this flood, the sawmill, dam, and pond full of logs were all carried away.

From the same paper, under an Embreeville, Tennessee, dateline, is quoted:

> The great flood swept through this place last Tuesday and done great damage. Nine houses were washed away. Seven families were left without homes. Some lost everything except the clothes they wore. The railroad was washed from its bed and scattered through the fields. The foot bridge, railroad bridge, ferry boat and both wagon bridges were washed away. The damage up to this time cannot be estimated.

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*"The Flood Along Cane Creek, Mitchell County, North Carolina." Engineering News, August 7, 1902, Vol. XLVIII, No. 6, pp. 102-104.

Other articles from the paper follow:

> Chuckey City, Tennessee, May 27. --All talk here is of the flood. The bridge across Chucky River (Nolichucky), about half a mile from this place, was swept away and several buildings belonging to Mr. N. P. Earnest were destroyed. The water ran up into his mill and destroyed quite a lot of flour, corn, etc. . . . The saddest part of the flood was the drowning of three little colored children. Their father had left them in what he thought was a safe place, only to return and find them swept away by the swift water.

February 28, 1902

The second highest known flood on the Nolichucky River in the vicinity of Erwin occurred on this date, but little information is available concerning it. Major flooding occurred on most of the streams in the eastern portion of the Tennessee Valley at the time, and at Knoxville the flood is the third highest known flood on both the Tennessee and the French Broad Rivers. On the Holston River in the vicinity of Knoxville it is the fourth highest known flood.

At Unaka Springs, 3 miles upstream from Erwin, a high water mark indicates that the flood was only 1.5 feet lower than the 1901 flood, and exceeded the 1940 flood by 1.9 feet. There were apparently no great floods on North or South Indian Creeks, since a high water mark at Taylor bridge, 9 miles downstream from Erwin, is 1.5 feet lower than the 1940 flood and 6.9 feet lower than the 1901 flood.

Floods of January and November 1906

No information was found concerning these floods in the vicinity of Erwin. However, during this period the U. S. Geological Survey had a stream gage on the Nolichucky River at Jones bridge near Greeneville, 41 miles downstream from Erwin. On January 23, 1906, a peak discharge of 73,500 cubic feet per second was observed, and on November 19, 1906, the peak discharge was 43,500 cubic feet per second. Flows in the river in the vicinity of Erwin would have been slightly less, but both floods would have been great enough to place them in the top ten of the known floods on the Nolichucky River.

July 16, 1916

In the extreme headwaters, that part of the North Toe above Boonford, the 1916 flood exceeded that of 1901. This flood resulted from rains generally confined to a narrow strip along the Blue Ridge.

Waters ran several feet deep down the main street of Spruce Pine, North Carolina, and damaged store goods to some extent.

Greatest single loser from the flood was the Clinchfield Railroad, whose lines had since 1901 been extended from Erwin up the Nolichucky and North Toe Rivers and across the Blue Ridge at Altapass. At the office of the Chief Engineer at Erwin, Tennessee, files were examined containing the reports of engineers making a reconnaissance of the flooded area. These showed the track to be almost completely wrecked from Spruce Pine to Unaka Springs, just upstream from Erwin. Tracks were in some places thrown to the opposite bank or carried several hundred yards downstream. Fills were washed badly throughout the length of the line. It was several weeks before service could be resumed.

No newspaper accounts of the flood could be found, all files of newspapers in the valley for this period being lost.

March 26, 1935

This was an important flood in the lower reaches of the Nolichucky River, but in the vicinity of Erwin it was only a minor flood on the river, being about 8 feet lower than the 1940 flood at the Embreeville stream gage. However, at the time of the 1948 investigation on North Indian Creek, several residents pointed out the height reached by the flood of March 1935 and stated that it was the highest flood they had witnessed on the creek at least since 1915. A comparison with floods since 1948 is difficult because of channel changes resulting from sand and gravel removal in the reach covered by the 1948 investigation. One high water mark at Mile 4.5 is about the same height as the floods of 1963 and 1965.

August 13, 1940

The intense rainfall on August 13 over the headwater tributaries, North Toe, South Toe, and Cane Rivers, resulted in the highest floods in recent

years throughout the Nolichucky River basin. On the main river, the flood came within 2 to 5 feet of the 1901 flood, the maximum of record. On two of the headwater tributaries, Cane River and South Toe River, the flood was the highest known. On North Toe River, the flood was 2 to 8 feet lower than the floods of 1901 and 1916, the maxima of record.

The heaviest rainfall recorded in the basin was 14.33 inches at Mount Mitchell. Rainfall for the storm exceeded 10 inches all along the crest of the Blue Ridge from Spruce Pine north to Newland at the head of the North Toe River. From the Blue Ridge, amounts decreased westward to 5.06 inches at Bakersville and 4.69 inches at Tipton Hill. South of Spruce Pine along the crest of the Blue Ridge and in the upper South Toe basin, amounts for the storm ranged mostly from 13 to 14 inches, except for a small area near Busick in the South Toe drainage area where only about 8 inches fell. From the junction of the North Toe and Cane Rivers to Embreeville, the storm rainfall was from 3 to 5 inches. Below Embreeville, in the lower end of the basin, storm totals were mostly under 2 inches.

Headwater streams began rising early Tuesday morning, August 13, and continued to rise sharply with continued heavy rainfall. Banks were overtopped generally before noon along the Cane and South Toe and in early afternoon along the North Toe. Heavy road and bridge damage occurred over the Cane, South Toe, and North Toe basins. Travel was at a standstill during periods from a few hours to 12 hours or more because of high water. Telephone service was disrupted. Crops were washed out in the narrow bottoms, and lands were eroded and covered with sand, gravel, and boulders. The Clinchfield Railroad suffered considerable damage when the river overflowed a section of the track in the gorge upstream from Erwin. Nearly a mile of track was washed out and the roadbed was scoured to bedrock in places. About 60 poles on the railroad telegraph and telephone system were washed out.

At Embreeville, the flood exceeded the 1916 flood by about 2 feet but was about 5 feet under the 1901 flood. Below Embreeville, the wide river bottoms were overflowed Tuesday evening, and the rise continued until early Wednesday. Crops were ruined, two main-river bridges were washed out, and gravel-surfaced roads were badly scoured. The crest dropped rapidly farther downstream, and was more than 12 feet below the 1901 flood downstream from Nolichucky Dam.

Figure 6. --NORTH INDIAN CREEK ABOVE ERWIN, MARCH 6, 1963

This view in the Rock Creek section is northwesterly at the point where the road from the fish hatchery intersects the road along left bank of creek, and shows a washed-out footbridge that led to the house on right bank.

(Photo by Johnson City Press-Chronicle)

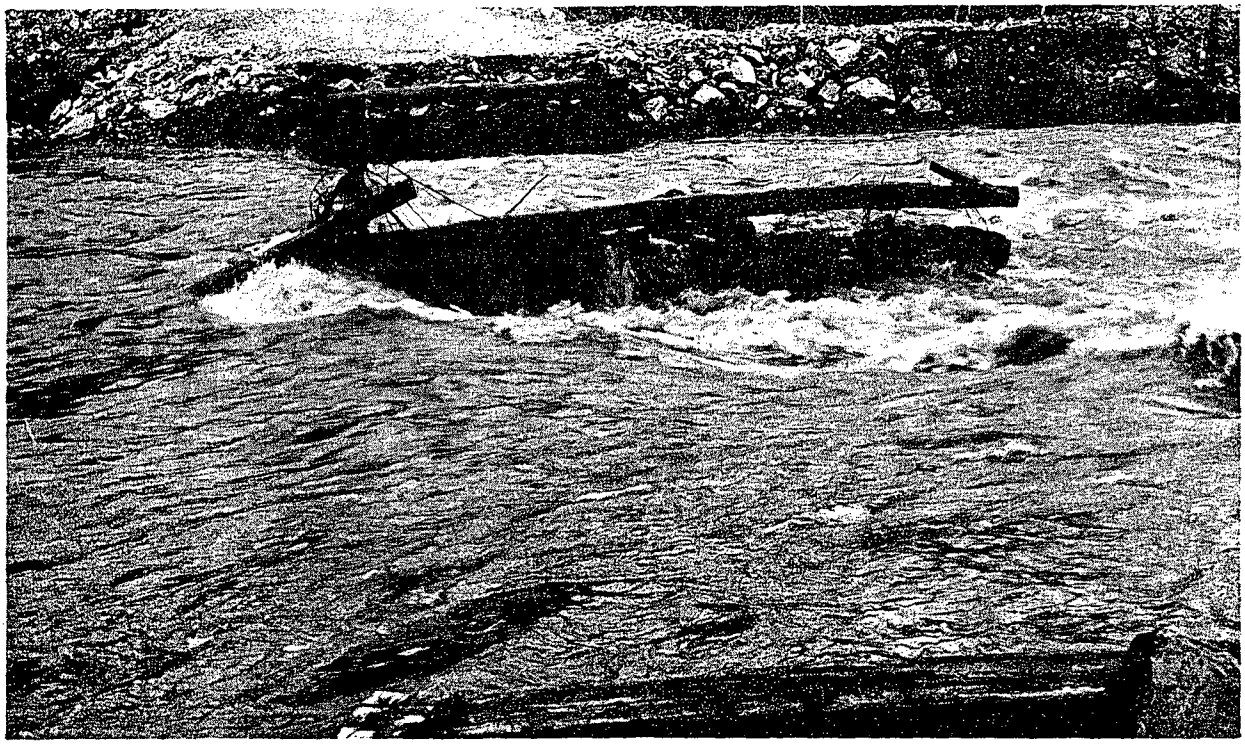
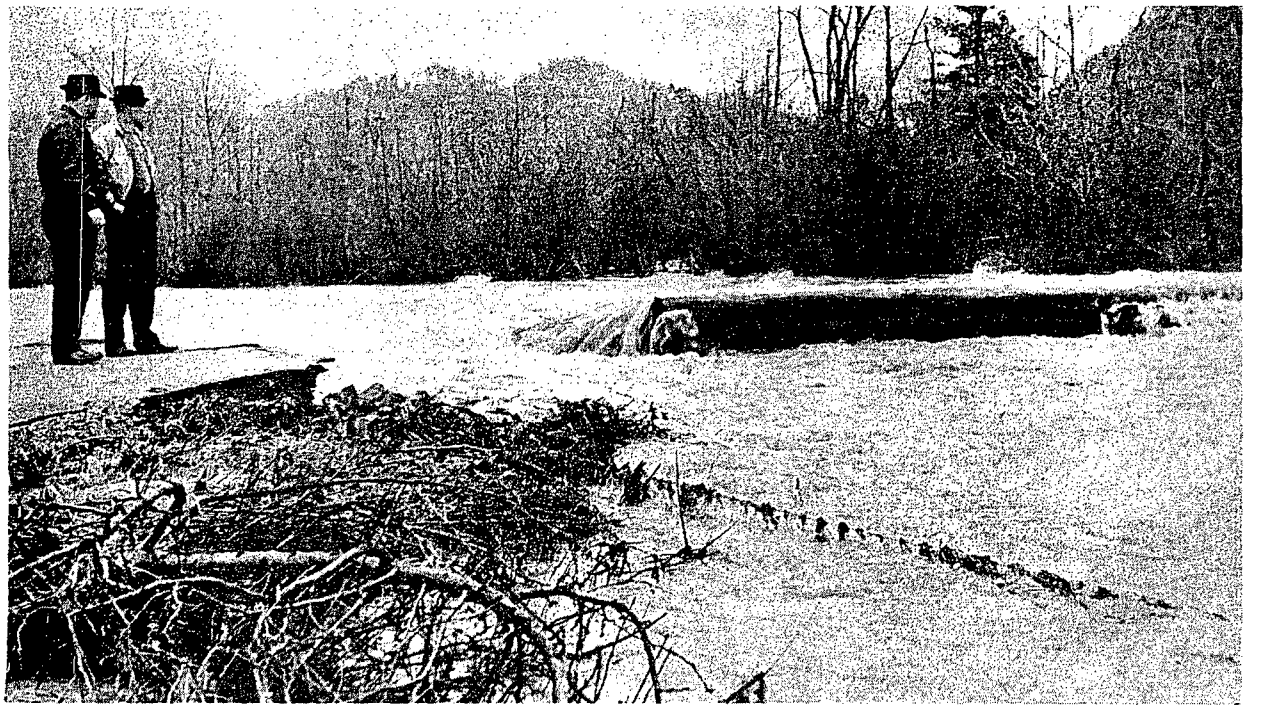


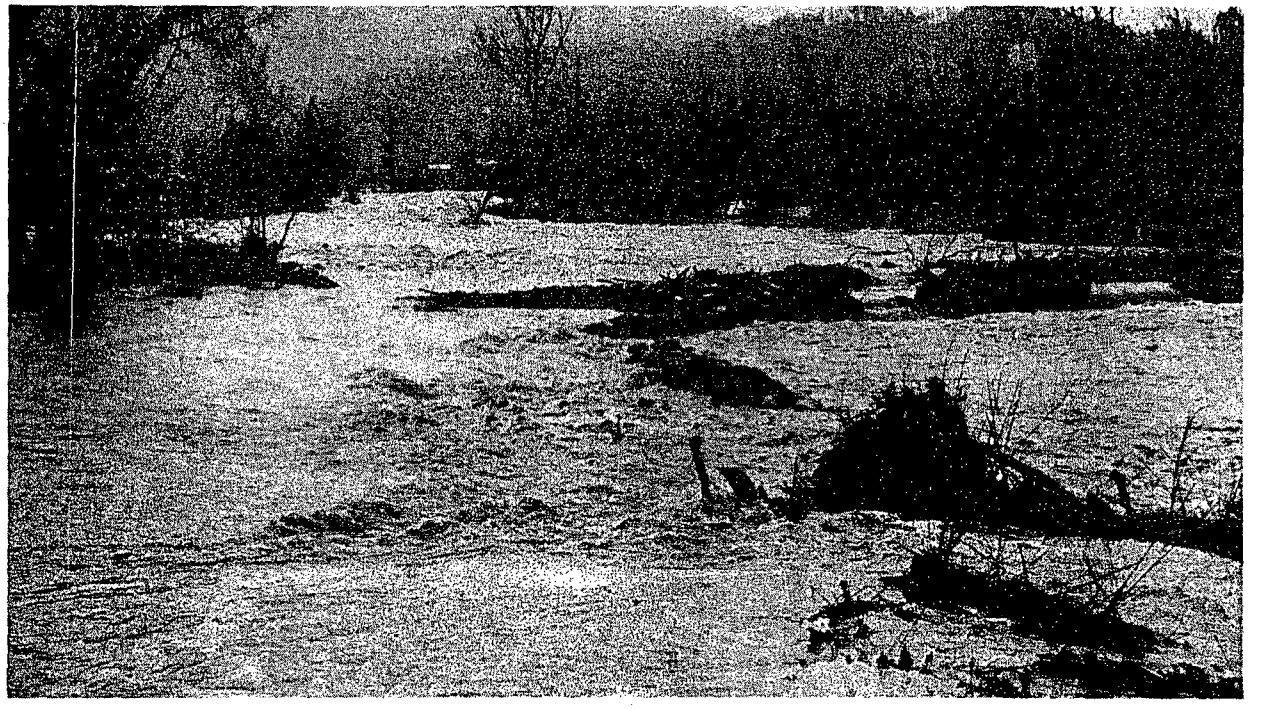
Figure 7. --SOUTH INDIAN CREEK ABOVE RIVERVIEW, MARCH 6, 1963

An 80-foot bridge, built here in 1961, was the longest wooden bridge in Unicoi County until this washout. The flood crest was 2 feet above the top crib member on left abutment. The replacement for the structure is shown in lower view of Figure 5.

(Photo by Johnson City Press-Chronicle)



(Photo by Johnson City Press-Chronicle)



(Photo by Erwin Record)

Figure 8. --SOUTH INDIAN CREEK AT RIVERVIEW, 1963 AND 1965

Upper view shows washout of March 6, 1963, at the Riverview bridge, Mile 0.34, when the crest reached a level 5 feet above the piers. Lower view shows water flowing over the road on March 26, 1965, when the level was approximately a foot below crest stage. The views are southwesterly from right bank.

Flood damage in the Nolichucky River basin was estimated to be close to $400,000. Fortunately, no lives were lost.

March 6 and 12, 1963

Rivers and creeks in the upper Nolichucky and North Toe River watershed exceeded flood stages on one or both dates and caused damage to roads, bridges, and farmlands along the streams. At Embreeville on March 12 the Nolichucky River reached the highest stage since 1940, but was 6 feet lower than that flood. The Clinchfield Railroad suffered the greatest loss in this region, where slides and washouts along the North Toe River stopped traffic on the line from 3 p.m. March 12 to 8 p.m. March 14. Repairs to the line were estimated to cost $60,000. This does not include loss of business or possible damage to perishable freight caught on the line.

Along the Nolichucky River, bottom lands, roads, and bridges between Erwin and Douglas Reservoir were flooded. In the Lowland area near Morristown, wide bottoms were flooded, endangering livestock and stranding families in their homes.

Tributary streams went out of banks, tearing out bridges and damaging roads and farmlands. In the vicinity of Erwin, North and South Indian Creeks and Rock Creek caused some damage. Figures 6, 7, and 8 show photographs of the flood of March 6 on the creeks in the vicinity of Erwin.

March 26, 1965

Most of the Nolichucky River tributaries downstream from the North Carolina-Tennessee state line experienced high stages during this flood. North Indian Creek reached the highest stage since the gage was installed in 1944, and flooded several homes in the Fishery community near Erwin. South Indian Creek flooded homes in the communities of Flag Pond and Ernestville. Highway officials in Unicoi County reported that the total damage to the county roads and bridges was $21,500, or slightly more than in 1963. More than $9,000 of this was for bridge repair, and the rest for repairing scoured blacktop and gravel roads, of which there were about 14 miles. A photograph of the flood on South Indian Creek is shown in Figure 8.

TABLE 11

FLOOD CREST ELEVATIONS AND DISCHARGES

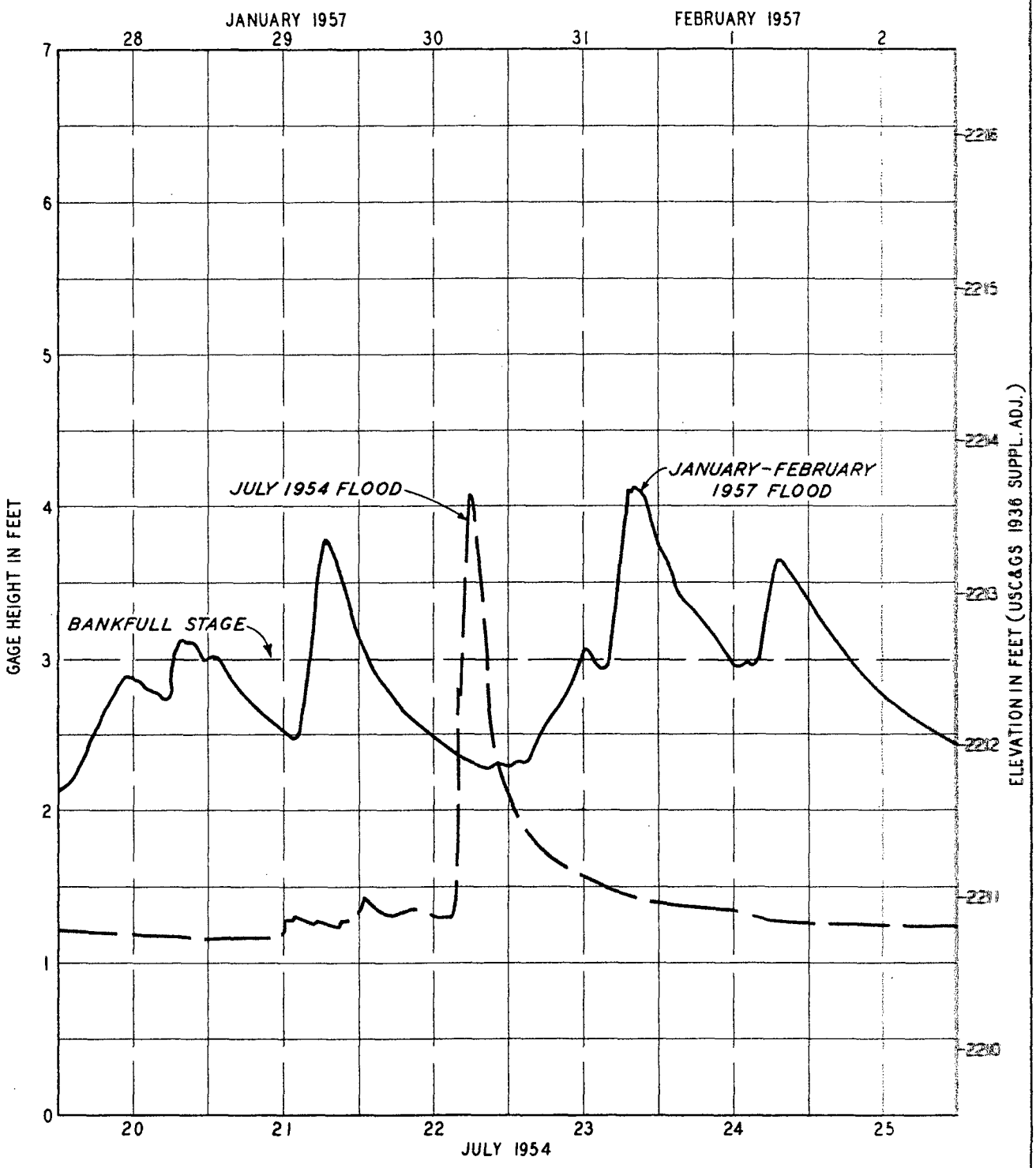
NORTH INDIAN CREEK NEAR UNICOI, TENNESSEE

1944-1966

This table includes all known floods above bankfull stage of 3 feet at the U. S. Geological Survey stream gaging station on North Indian Creek near Unicoi, Tennessee, located at Mile 10.8. Drainage area = 15.9 square miles. Zero of gage = 2209.56 feet.

Date of Crest	Gage Height		Peak Discharge	
	Stage	Elevation	Amount	Per Sq. Mi.
	feet	feet	cfs	cfs
January 7, 1946	3.40	2212.96	342	22
February 10, 1946	3.22	2212.78	310	19
January 20, 1947	3.06	2212.62	277	17
February 9, 1950	3.03	2212.59	263	17
May 11, 1950	3.10	2212.66	278	17
December 7, 1950	3.54	2213.10	362	23
June 22, 1951	3.12	2212.68	282	18
February 21, 1953	3.55	2213.11	358	23
July 22, 1953	3.72	2213.28	398	25
January 22, 1954	3.87	2213.43	334	21
July 22, 1954	4.08	2213.64	486	31
March 19, 1955	3.13	2212.69	266	17
February 17, 1956	3.11	2212.67	261	16
April 15, 1956	3.48	2213.04	343	22
July 16, 1956	3.31	2212.87	305	19
January 29, 1957	3.78	2213.34	468	29
January 31, 1957	4.13	2213.69	495	31
February 10, 1957	3.42	2212.98	334	21
April 5, 1957	3.69	2213.25	394	25
May 27, 1957	3.37	2212.93	323	20
January 21, 1959	4.30	2213.86	536	34
March 27, 1959	3.30	2212.86	300	19
September 30, 1959	3.22	2212.78	290	18
December 19, 1959	3.38	2212.94	320	20
July 1, 1960	3.18	2212.74	280	18

PLATE 5



Stream Gage at
River Mile 10.80

TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

STAGE HYDROGRAPHS

NORTH INDIAN CREEK
NEAR
UNICOI, TENN.

MARCH 1967

interval of the maps does not permit precise plotting of the flooded area boundaries. The contour interval on Plates 8 and 9 is 40 feet.

Plate 11 shows the high water profile on North Indian Creek for the flood of March 26, 1965. Also shown are the profiles for the Regional and Maximum Probable Floods, which are discussed in Sections V and VI of this report.

Plate 12 shows typical cross sections of North Indian Creek in the reach investigated. The locations of the sections are shown on the maps, Plates 8 and 9, and the profile, Plate 11. Each cross section shows the elevation and extent of overflow of the March 26, 1965, flood and the Regional and Maximum Probable Floods.

FLOOD DESCRIPTIONS

Descriptions of the large floods on North Indian Creek are included with the discussion of past floods on Nolichucky River.

3. SOUTH INDIAN CREEK

Flood Records

Records of stream stage and discharge have not been maintained on South Indian Creek. To develop information on floods, local residents have been interviewed for information on dates and heights of floods, and newspaper files have been searched. High water marks were located in the field to develop in detail the flood crest profile for the flood of March 26, 1965.

Flood Occurrences

The investigation indicates that major floods have occurred at about the same frequency on South Indian Creek as on North Indian Creek.

Duration and Rate of Rise

On South Indian Creek the duration of flooding and the rate of rise during floods would be similar to that on North Indian Creek.

Velocities

Along South Indian Creek in the reach investigated, velocities in the channel during floods such as that of 1965 would range up to 10 feet per second, and in the overbank areas velocities would be as high as 4 feet per second. During larger floods, velocities would be greater.

Flooded Areas, Flood Profiles, and Cross Sections

Plate 10 shows the approximate area along South Indian Creek that was inundated by the flood of March 26, 1965, and that would be inundated by the Maximum Probable Flood. The actual limits of the overflow area on the ground may vary somewhat from that shown on the map because the contour interval of the map does not permit precise plotting of the flooded area boundaries. The contour interval on Plate 10 is 40 feet.

Plate 11 shows the high water profile on South Indian Creek for the flood of March 26, 1965. Also shown are the profiles for the Regional and Maximum Probable Floods, which are discussed in Sections V and VI of this report.

Plate 12 shows typical cross sections of South Indian Creek in the reach investigated. The locations of the sections are shown on the map, Plate 10, and the profile, Plate 11. Each cross section shows the elevation and extent of overflow of the March 26, 1965, flood and the Regional and Maximum Probable Floods.

FLOOD DESCRIPTIONS

Descriptions of the large floods on South Indian Creek are included with the discussion of past floods on Nolichucky River.

V.

REGIONAL FLOODS[1]

This section of the report relates particularly to floods on streams whose watersheds are comparable with those of the Nolichucky River, North Indian and South Indian Creeks.

Large floods have been experienced in the past on streams in the general geographical and physiographical regions of Erwin, Tennessee. Heavy storms similar to those causing these floods could occur over the watersheds of Nolichucky River, North Indian and South Indian Creeks. In this event, floods would result on these streams comparable in magnitude with those experienced on neighboring streams. Floods of this size are designated as Regional Floods. It is therefore desirable, in connection with any determination of future floods which may occur on the Nolichucky River, North Indian and South Indian Creeks, to consider floods that have occurred in the region on watersheds whose topography, watershed cover, and physical characteristics are similar to those of these three streams.

Maximum Known Floods in the Region

The watersheds of the Nolichucky River above Erwin and of North Indian and South Indian Creeks lie within the southern Appalachian Mountains. Storm rainfall over the watersheds in this region is influenced considerably by the topography. This is true of the tropical summer hurricanes as well as the large cyclonic storms of the winter months. Warm moist air moving northward and westward from the Atlantic and Gulf Coasts is forced upward by the gradually sloping ground rising to the crest of the Tennessee Valley Divide. As a result, the eastern slopes of the Divide and the area immediately beyond the crest within the Valley are subject to heavy orographic rainfall. On the eastern slopes of the Divide this heavy rainfall is generally widespread and covers entire river basins, while within the Tennessee Valley the heavy precipitation is confined largely to a narrow band along the top and immediately beyond the Divide. It diminishes on the downstream western slopes, although occasionally tongues or cells of heavy rainfall have been experienced for considerable distances within the Valley.

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1. Prepared by Hydraulic Data Branch.

TABLE 14

MAXIMUM KNOWN FLOOD DISCHARGES ON STREAMS

IN THE REGION OF ERWIN, TENNESSEE

No.	Stream	Location	Drainage Area sq. mi.	Date	Peak Discharge Amount cfs	Peak Discharge Per Sq. Mi. cfs
1	Nolichucky River	nr Greeneville, Tenn.	1141	May 22, 1901	110,000	96
2	French Broad River	at Asheville, N. C.	945	July 16, 1916	110,000	116
3	Nolichucky River	at Embreeville, Tenn.	805	May 1901	120,000	149
				August 13, 1940	82,500	102
4	Watauga River	at Elizabethton, Tenn.	692	May 1901	75,900	110
5	Tuckasegee River	at Bryson City, N. C.	655	May 1840	90,000	137
6	Nolichucky River	at Poplar, N. C.	608	July 1916	93,000	153
7	Watauga River	at Butler, Tenn.	427	August 13, 1940	71,500	167
8	Little Pigeon River	at Sevierville, Tenn.	353	February 25, 1875	55,000	156
9	Tuckasegee River	nr East Laport, N. C.	200	August 30, 1940	45,000	225
10	Pigeon River	at Canton, N. C.	133	August 30, 1940	31,600	238
11	Swannanoa River	at Biltmore, N. C.	130	April 1791	40,000	308
12	North Toe River	at Altapass, N. C.	104	July 16, 1916	30,800	296
13	Watauga River	nr Sugar Grove, N. C.	90.8	August 13, 1940	50,800	559
14	Sandymush Creek	nr Alexander, N. C.	79.5	August 30, 1940	20,000	252
15	South Toe River	at Newdale, N. C.	60.8	August 13, 1940	29,400	484
16	East Fork Pigeon River	nr Canton, N. C.	51.5	February 13, 1966	12,100	235
17	Caney Fork	above Cowarts, N. C.	39.4	August 30, 1940	21,700	551
18	Newfound Creek	nr Leicester, N. C.	34.2	August 30, 1940	12,000	351
19	North Fork Swannanoa River	nr Black Mountain, N. C.	23.8	June 16, 1949	16,500	693
20	Cane Creek	above Bakersville, N. C.	22.0	May 19-20, 1901	30,500	1390
21	West Fork Pigeon River	nr Waynesville, N. C.	12.2	August 30, 1940	16,500	1350

Because of the rainfall distribution, flooding on streams within the Tennessee Valley is not usually so severe as on those streams whose watersheds lie to the south and east, outside of the Valley. Therefore, floods which have occurred on these streams have not been considered in the determination of Regional Floods on the Nolichucky River, North Indian and South Indian Creeks.

Table 14 lists the maximum known floods experienced on those watersheds within 80 miles of Erwin that lie in the Tennessee Valley and are comparable with the Erwin region. Included in the list are floods caused by both widespread general storms and those more local in nature.

Many very severe large storms have been experienced over the watersheds along the eastern Tennessee Valley Divide. The storms of May 1901, late August 1940, and the hurricanes of July 1916 and mid-August 1940 are four of the largest that have occurred since the turn of the century. The storm of May 18-21, 1901, caused particularly destructive floods in the Watauga and Nolichucky River basins and is the maximum flood of record on the Nolichucky River. During this storm an estimated 8 inches of rain fell in a 24-hour period on ground that was saturated from previous rains. Numerous "waterspouts" and landslides, reported in news accounts of the storm, attest to the intensity of the rainfall. In the Cane Creek watershed near Bakersville, North Carolina, as many as 17 landslides were counted on the side of a single hill; the resulting flood on that creek was in the order of a Maximum Probable Flood. This flood on the Nolichucky River became known as the "May Tide."

The storm of July 15-16, 1916, originated as a tropical hurricane that moved inland over the southeastern United States and brought heavy rainfall along the eastern Tennessee Valley Divide. The most severe flooding occurred along the upper French Broad River; however, a maximum point rainfall of 22.2 inches in a 24-hour period was recorded at Altapass, North Carolina, in the headwaters of the Nolichucky River, 40 miles northeast of Asheville.

The storm of mid-August 1940, like that of July 1916, originated as a tropical hurricane. The path of the storm center approximated a large "U" with the base along the Blue Ridge Mountains, one arm extending to Savannah, Georgia, and the other along the Virginia-North Carolina state line to the coast. Heavy rain fell along the eastern Tennessee Valley Divide from the Hiwassee

River basin northeast to the Watauga River headwaters. The highest floods of record were experienced on many streams in the region as a result of the rainfall, which exceeded 14 inches in some areas of the Watauga and Nolichucky River basins.

About $2\frac{1}{2}$ weeks later, on August 29-30, heavy rains fell over much of the same area as a result of thunderstorm activity. Rainfall totaling more than 10 inches caused record floods on the upper Tuckasegee River and its tributaries.

Other storms of a more local nature have also been experienced in the Erwin region. These storms often occur as a result of thunderstorm activity and, although not so widespread as the storms described previously, may cause severe flooding over a small area. The storm of June 13, 1924, was a severe local storm which produced extensive damage to a small area in Carter County. The heaviest part of the storm covered an oval area of about 50 square miles. At Cardens Bluff, Tennessee, near the present site of Watauga Dam, rainfall measured almost 15 inches in an 8-hour period; 12 inches of this fell within $3\frac{1}{2}$ hours. Because of the small area covered by the storm, only minor flooding occurred on the Watauga and Doe Rivers. No discharges on the smaller tributaries are available because steep slopes and large quantities of debris prevented making discharge estimates. On one ravine with a drainage area of only 15 acres, two houses were demolished and nine of the occupants drowned. One occupant who escaped with severe injuries stated that a wall of water, rock, and earth 8 to 10 feet high crashed into these houses without warning.

The June 14-16, 1949, storm was part of a widespread disturbance that produced floods of considerable magnitude throughout much of the southeastern Tennessee Valley. In the Swannanoa River watershed 8.50 inches of rainfall was recorded in 21 hours, producing a flood on the North Fork Swannanoa River second only to the great flood of July 1916.

All of the flood discharges listed in Table 14 have occurred on watersheds that are similar in physical characteristics to the watersheds of Nolichucky River, North Indian and South Indian Creeks. This indicates that floods of like magnitude, modified to take into account differences in drainage area characteristics, could occur in the future over these three streams.

Determination of Regional Floods

Plate 6 is a diagram of the discharges tabulated in Table 14 together with a map showing the location of the discharge measurements. As seen from the plate, the most outstanding floods in the Erwin region were caused by the storms of May 1901, July 1916, mid-August 1940, and late August 1940. The July 1916 flood and the mid-August 1940 flood were caused by decadent hurricanes with the heaviest rainfall along the Tennessee Valley Divide. The headwaters of the Nolichucky River lie along the Divide and would be susceptible to this heavy rainfall. North Indian Creek and South Indian Creek watersheds lie about 30 miles west of the Tennessee Valley Divide and would not be so susceptible to the heaviest rainfall from this type of storm. Therefore, the flood discharges from these storms plotted on Plate 6 were not considered in drawing the experience line and determining the Regional Flood for these streams. The May 1901 storm caused flooding over a large area of eastern Tennessee. This flood was particularly destructive in the Nolichucky River basin, and on some of the tributaries approached the magnitude of a Maximum Probable Flood described in Section VI of this report. As seen from Plate 6, this flood on the Nolichucky River at Embreeville exceeded the experience line for the Erwin region. A high-intensity storm like that of late August 1940, although not covering so large an area as the previous storms, could cause severe flooding on the Nolichucky River and its tributaries.

In addition to the storms mentioned above, flooding on North and South Indian Creeks could be caused by storms like those of June 1924 in Carter County and June 1949 in the Swannanoa River basin. Such storms generally occur during the summer months, are local in nature with high rainfall intensity, and may cause severe flooding over a small area. Upon the basis of flood discharges experienced in the region, it is reasonable to expect future flood discharges on Nolichucky River, North Indian Creek, and South Indian Creek to be in the order of those given in Table 15. For the purposes of this report, floods of this magnitude are designated as Regional Floods.

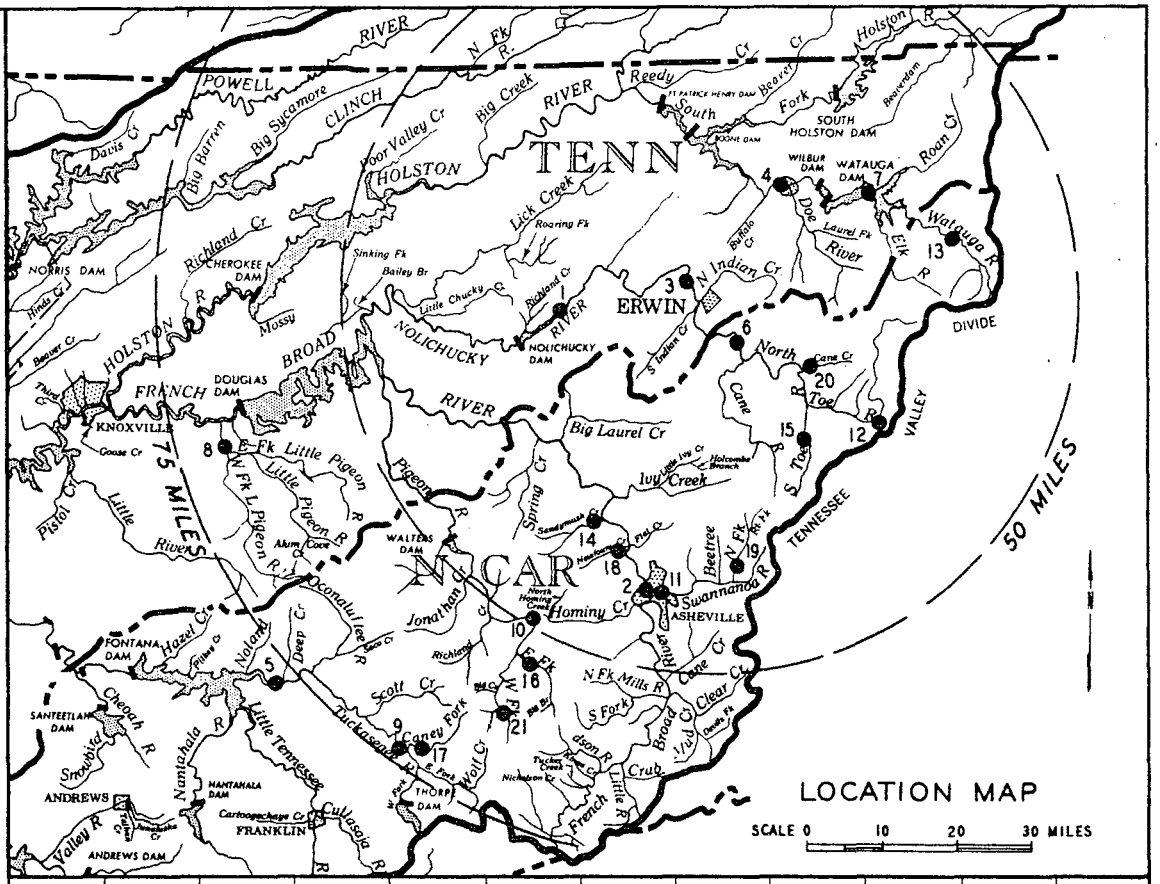
TABLE 15

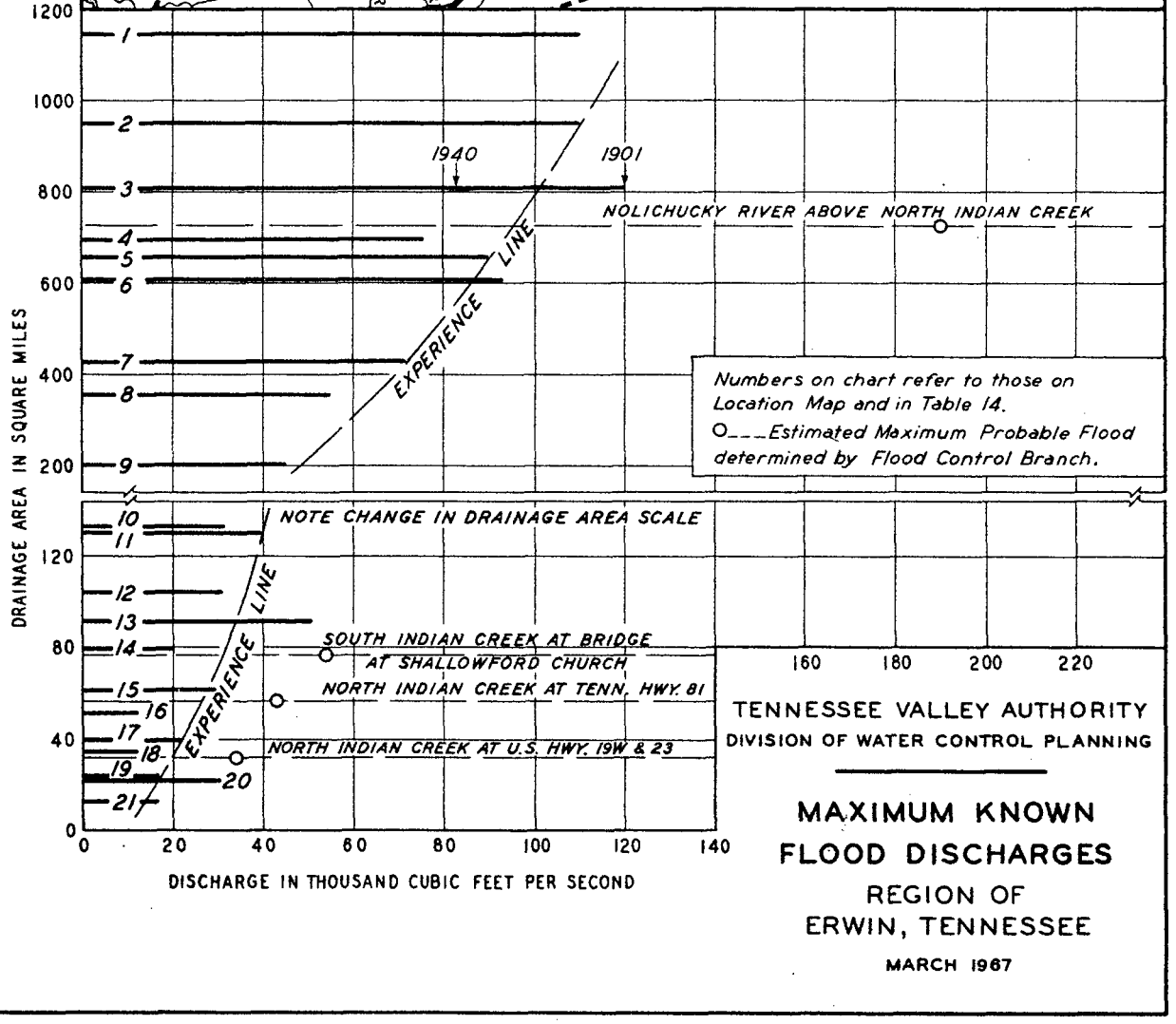
REGIONAL FLOOD PEAK DISCHARGES

Stream	Location	River Mile	Drainage Area sq. mi.	Discharge cfs
Nolichucky River	Above North Indian Creek	94.1	727	95,500
	Above South Indian Creek	95.6	639	89,000
North Indian Creek	Tennessee Highway 81	1.22	57.3	26,500
	U. S. Highway 19W & 23	6.75	32.7	20,000
South Indian Creek	Bridge at Shallowford Church	3.14	76.9	31,000

A Regional Flood may occur on Nolichucky River in the reach investigated that would be about midway between the floods of May 21, 1901, and August 13, 1940. In the immediate vicinity of Erwin, the Regional Flood would be about 2 feet higher than the 1940 flood, but 2 feet lower than the 1901 flood. On North Indian Creek a Regional Flood would be 1 to 16 feet higher, or an average of almost 8 feet higher, than the flood of March 26, 1965. A Regional Flood on South Indian Creek would exceed the 1965 flood by 4 to 12 feet, averaging 6 feet higher.

The profiles of the Regional Floods on Nolichucky River, North Indian Creek, and South Indian Creek are shown on Plate 11. Figures 9 to 15 show the heights that would be reached by the Regional Flood at several locations in the vicinity of Erwin.





TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

MAXIMUM KNOWN FLOOD DISCHARGES

REGION OF
ERWIN, TENNESSEE

MARCH 1967

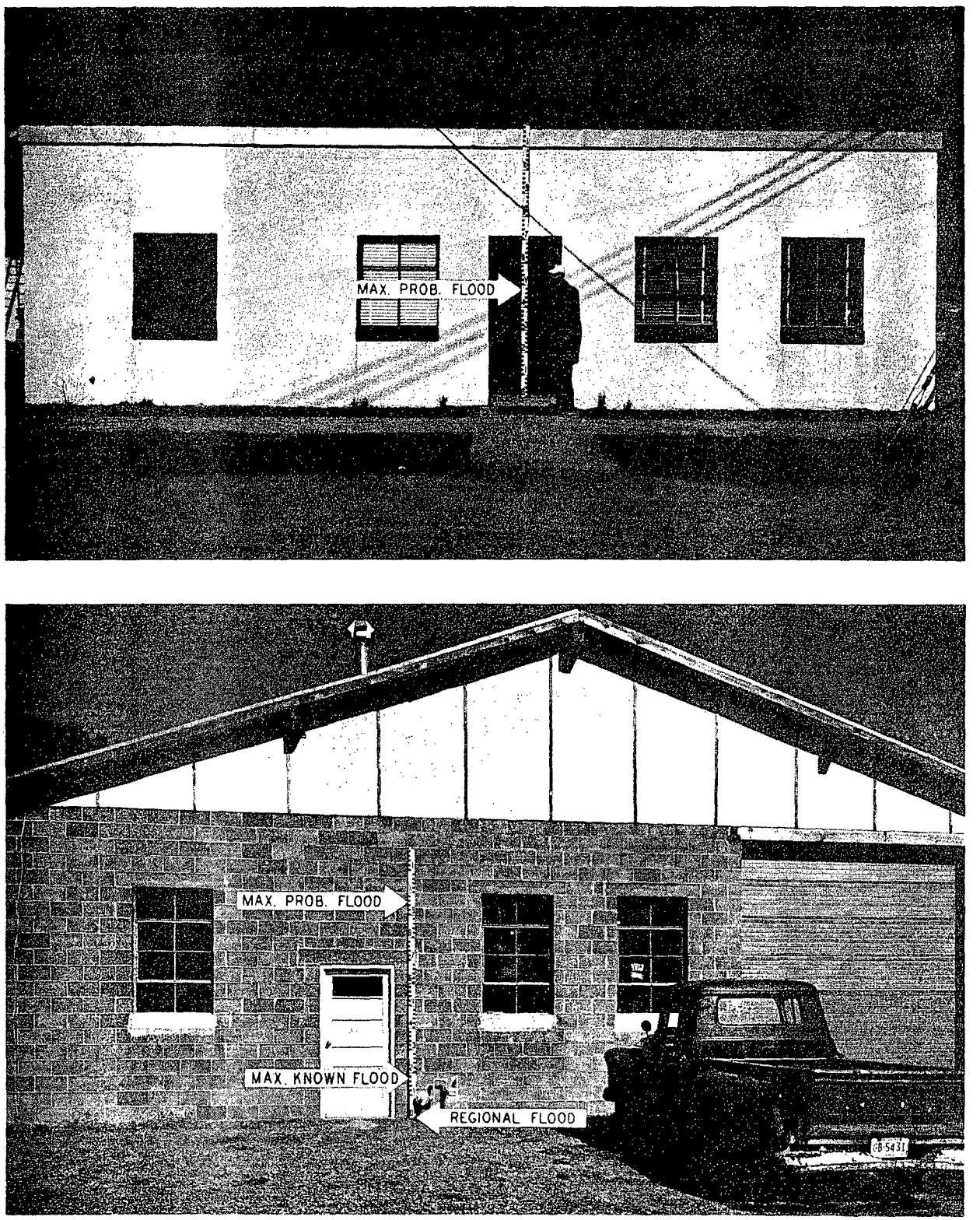
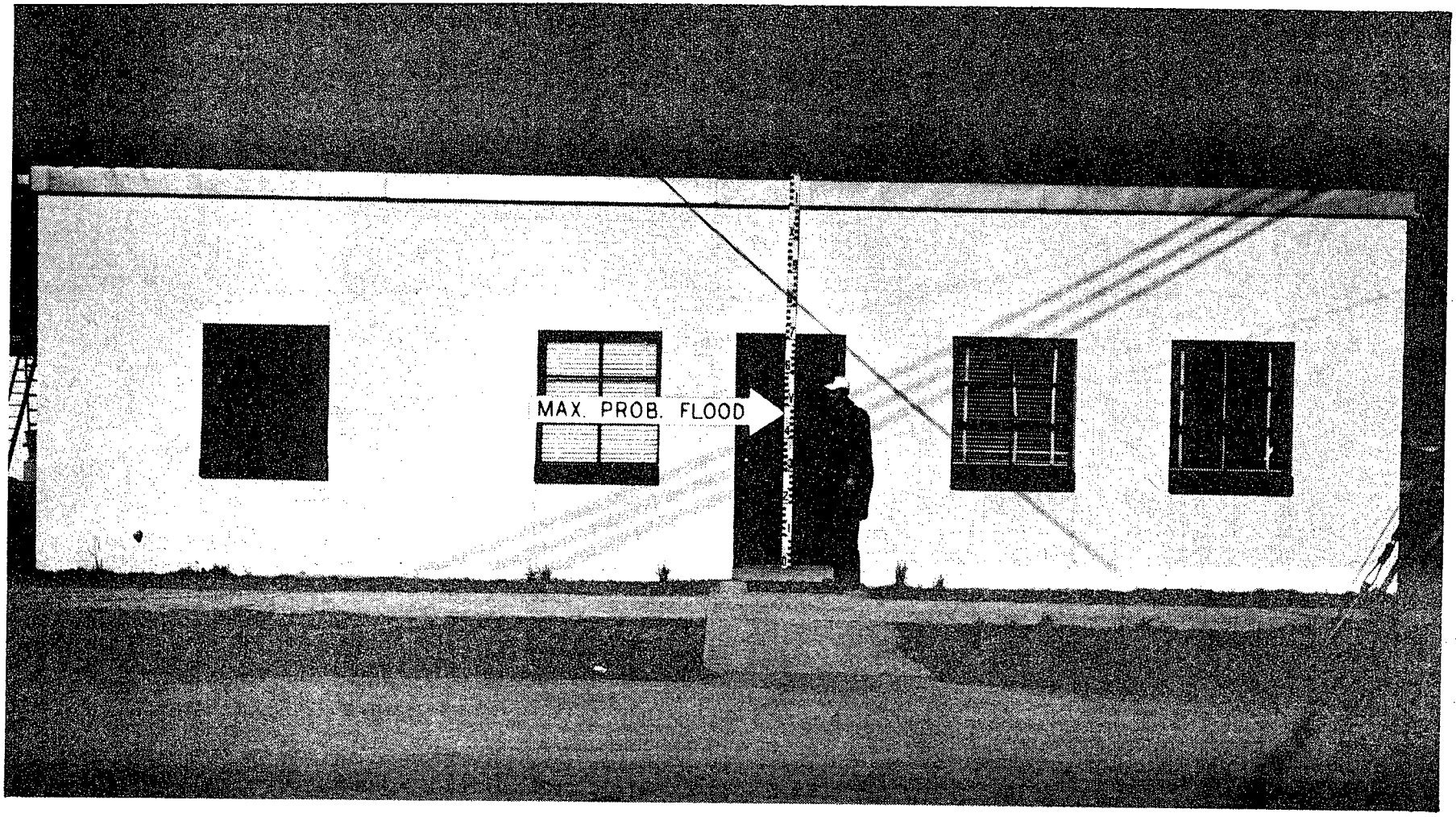
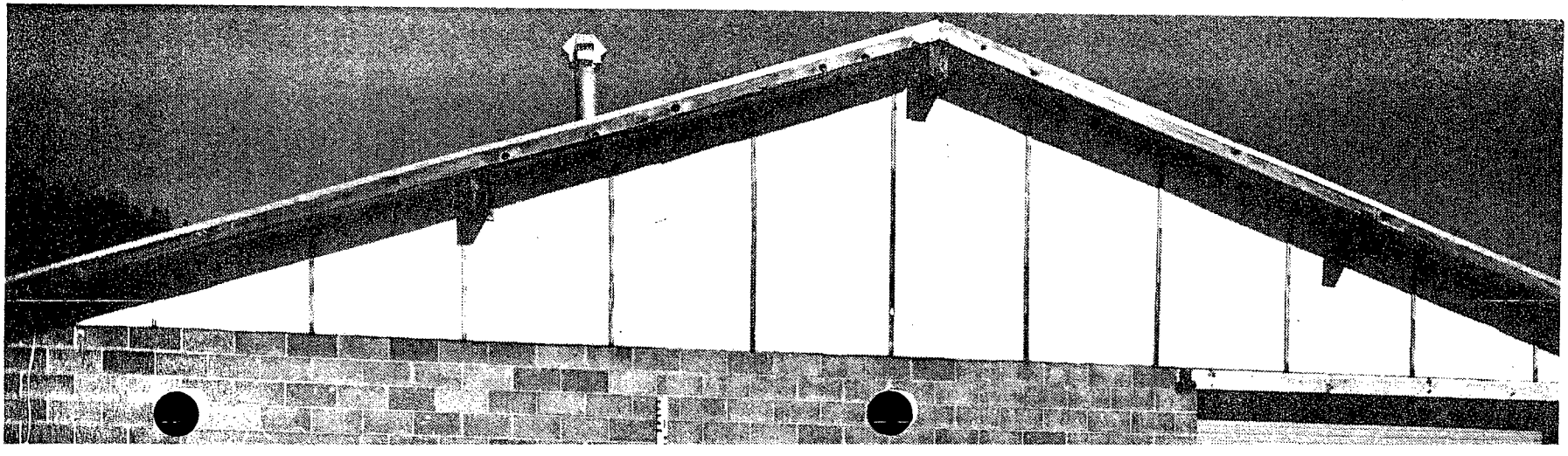


Figure 9. --NOLICHUCKY RIVER FLOOD HEIGHTS AT ERWIN

Upper view shows the administration building of Nuclear Fuel Services, Inc., at Mile 94.78. Lower view is the Unicoi County garage at Mile 95.83. Both buildings are on right bank of river. Arrows show heights of the maximum known (1901) flood and the Regional and Maximum Probable Floods. In upper view the Regional Flood would be 3.4 feet, and the 1901 flood 0.5 foot, lower than the base of the rod.


MAX. PROB. FLOOD



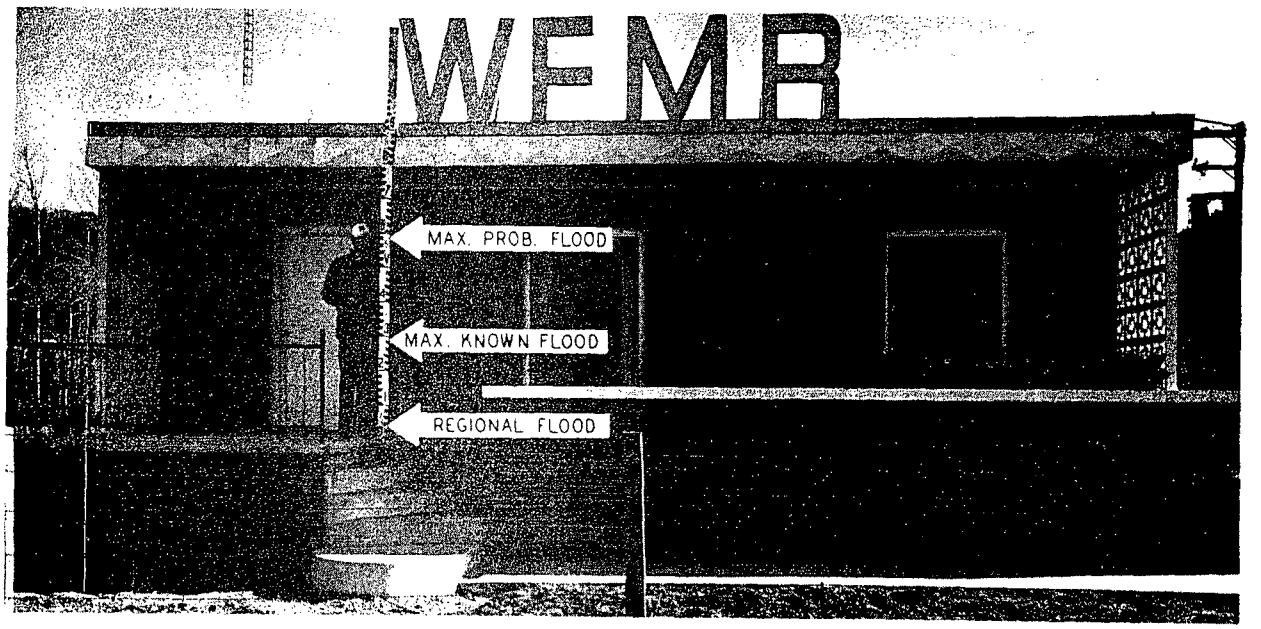


Figure 10. --NOLICHUCKY RIVER FLOOD HEIGHTS ABOVE ERWIN

This radio station building is on left bank at Mile 96.55. Arrows show heights of the maximum known (1901) flood and the Regional and Maximum Probable Floods.

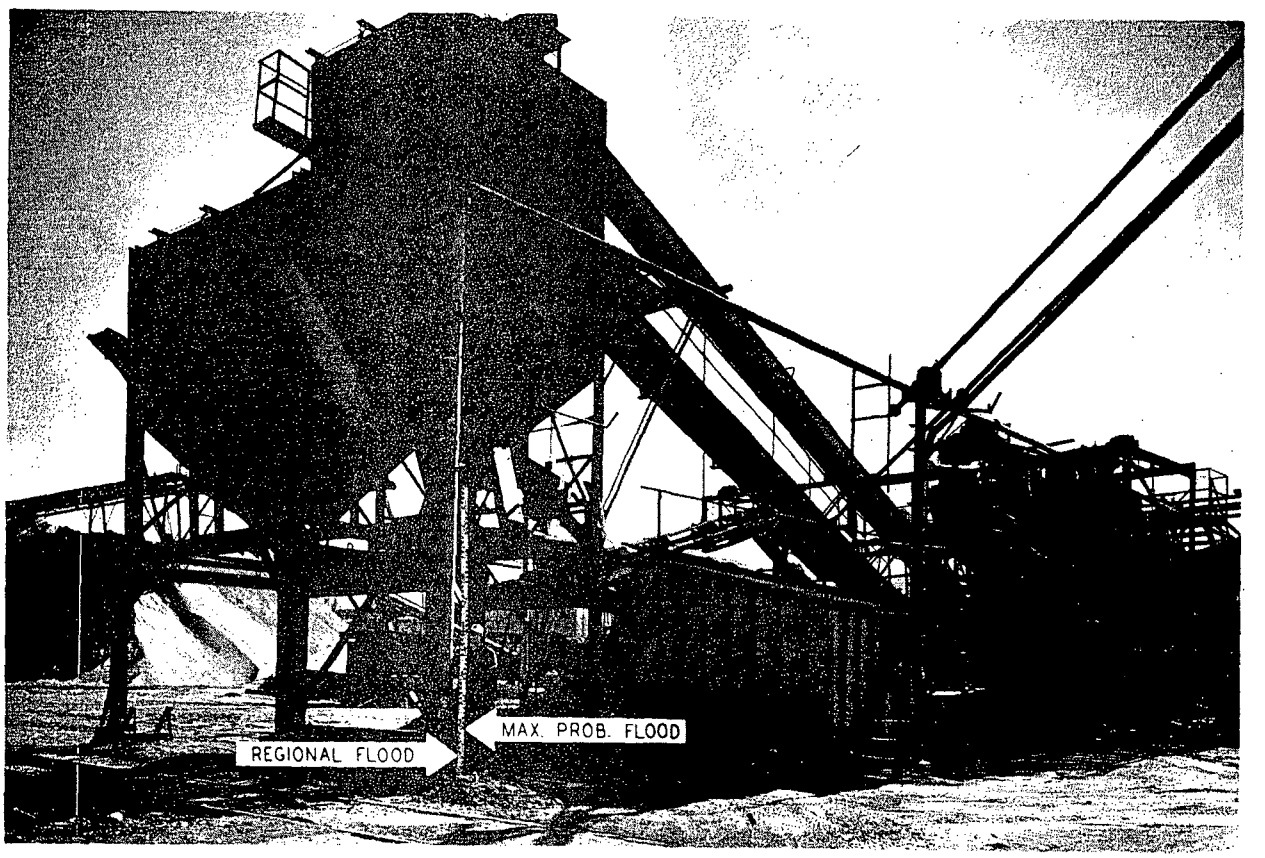


Figure 11. --FLOOD HEIGHTS AT VULCAN MATERIALS COMPANY

This plant is at Mile 0.73 of North Indian Creek in Erwin, near the railroad yards. Arrows show the Regional and Maximum Probable Flood heights.

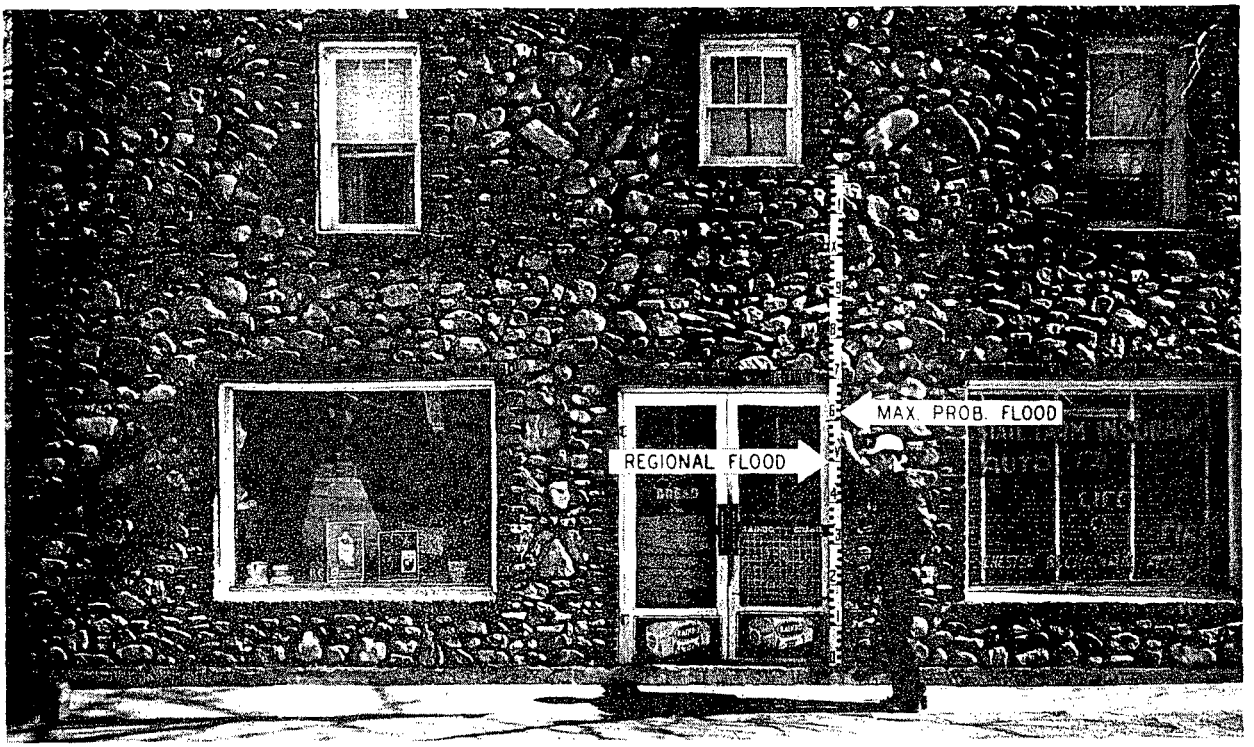


Figure 12. --FLOOD HEIGHTS ALONG TENNESSEE HIGHWAY 81

This store and insurance office building is on right bank of North Indian Creek at Mile 1.23. Arrows show the Regional and Maximum Probable Flood heights.

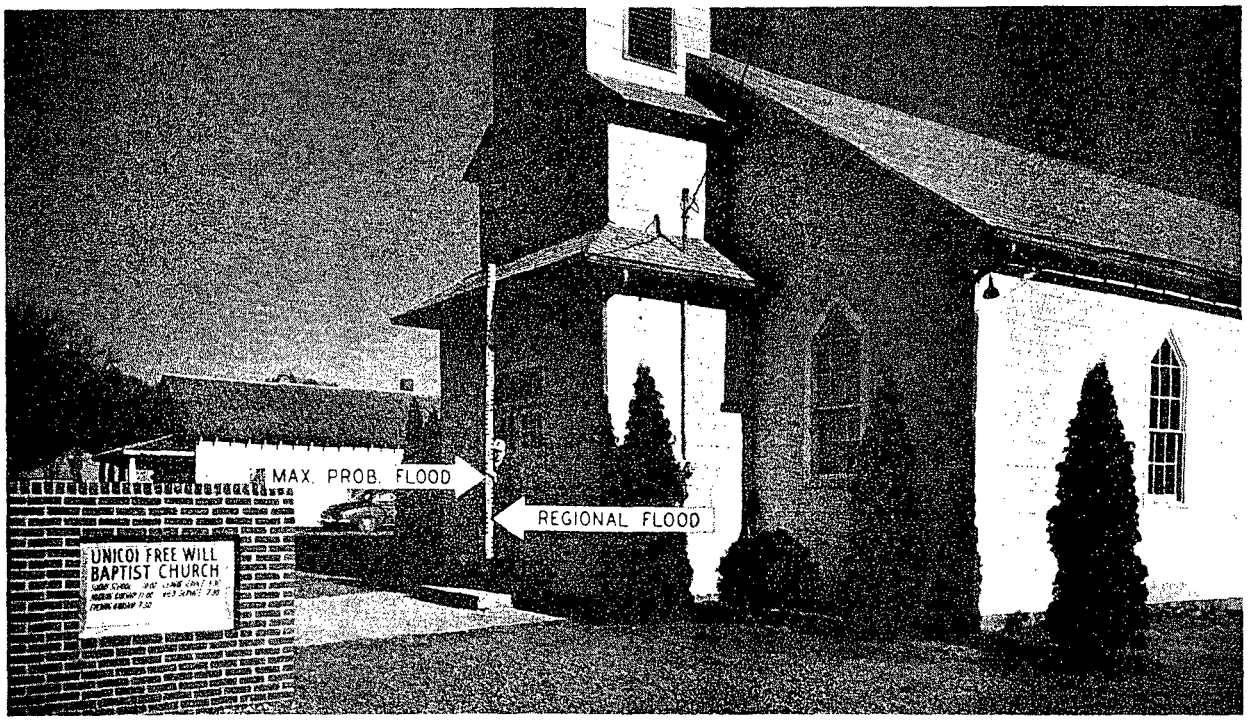


Figure 13. --FLOOD HEIGHTS IN UNICOI

The church is at Mile 6.48 of North Indian Creek, in a residential development on right bank. Arrows show heights of the Regional and Maximum Probable Floods.

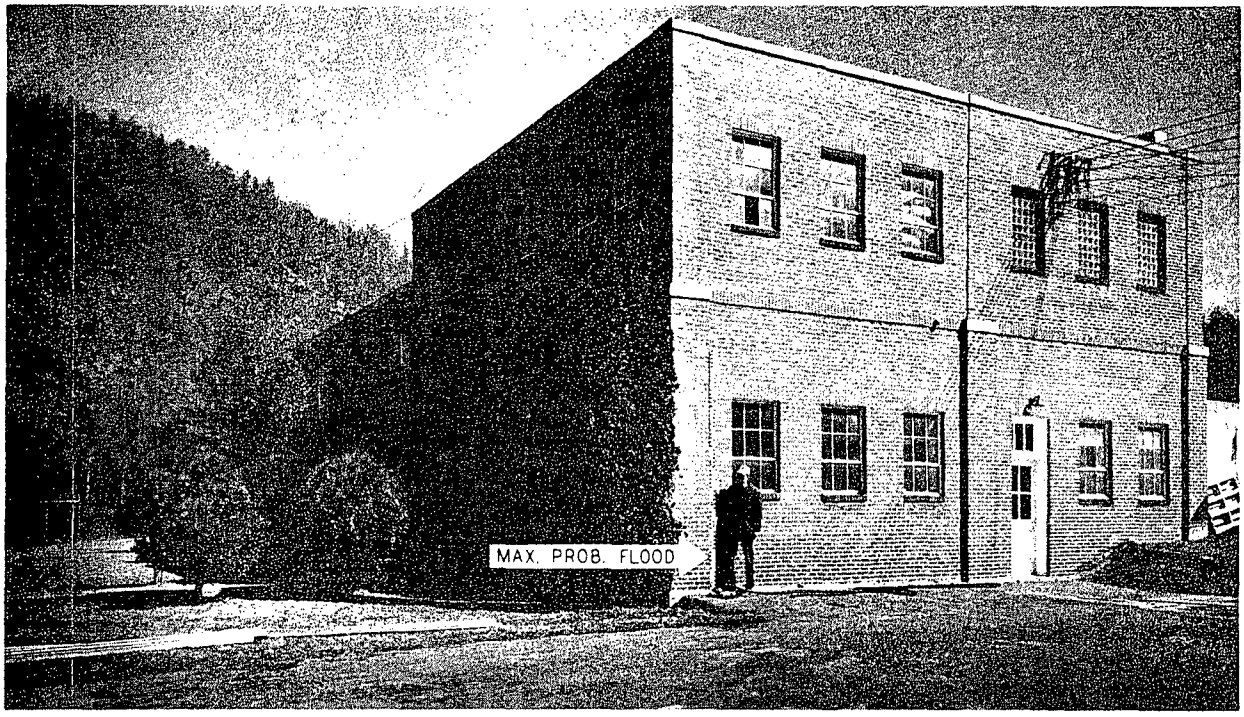


Figure 14. --FLOOD HEIGHTS UPSTREAM FROM UNICOI

The Johnson City water treatment plant is on the right bank of North Indian Creek at Mile 7.96. The Regional Flood would be 0.3 foot below the base of the rod. The arrow shows the Maximum Probable Flood height.

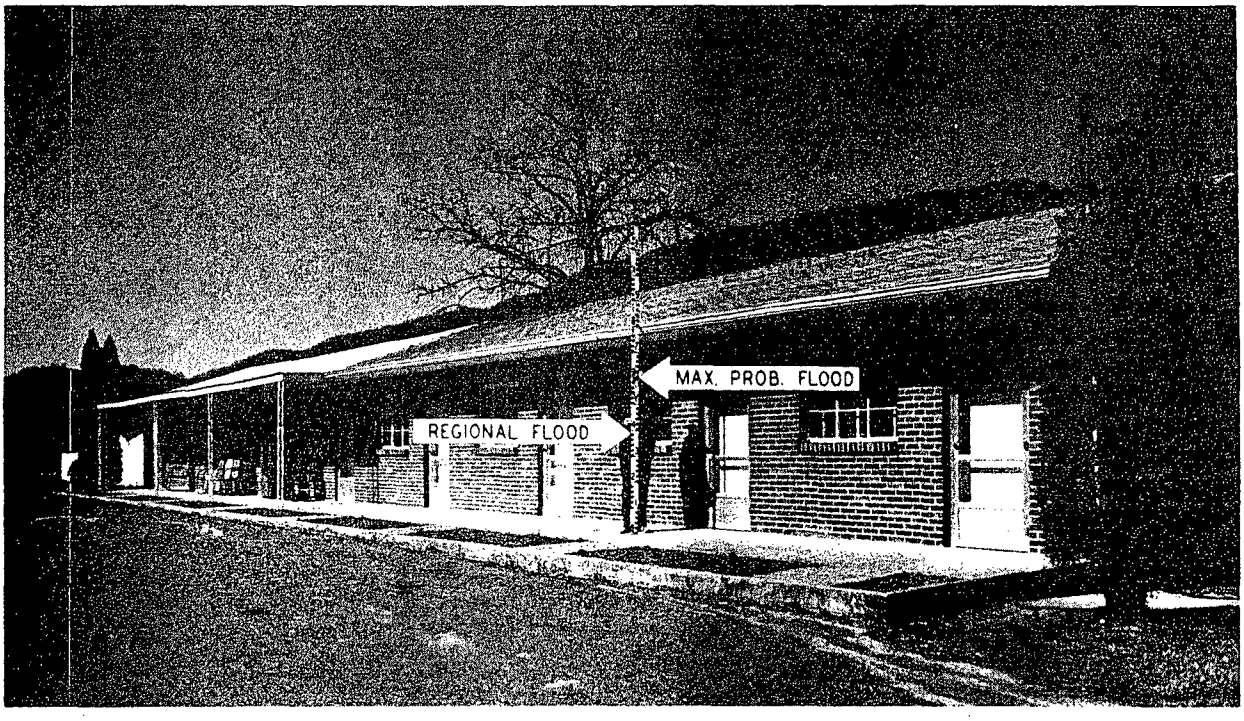


Figure 15. --FLOOD HEIGHTS ON SOUTH INDIAN CREEK

Moore's Motel is located at Mile 3.87 of the creek, along U. S. Highway 19W & 23. Arrows show heights of the Regional and Maximum Probable Floods.

VI.

MAXIMUM PROBABLE FLOODS[1]

This section discusses the Maximum Probable Floods on the Nolichucky River, North Indian and South Indian Creeks, and some of the hazards of great floods. Floods of the magnitude of the Maximum Probable are the kind considered in planning construction and operation of protective works, the failure of which might be disastrous. They represent reasonable upper limits of expected flooding.

The drainage areas at the lower and upper limits of the study on the Nolichucky River are 791 and 636 square miles, respectively. North Indian and South Indian Creeks have drainage areas of 59.3 and 81.0 square miles at their respective mouths and 23.6 and 72.5 square miles at the respective upstream study limits.

Extreme floods on these streams are most likely to result from either of two types of storms--intense periods of rainfall during winter storms of fairly long duration, or short-duration storms of the thunderstorm or hurricane type usually occurring during summer or early fall. Infiltration and other losses are generally low in winter and high in summer.

DETERMINATION OF FLOOD DISCHARGES

In determining the Maximum Probable Floods on the streams involved in this study, consideration was given to great storms and floods that have already occurred on these watersheds and to those which have occurred elsewhere but could have occurred in this area. This procedure provides information about possible floods and storms additional to that which can be gained from the short-term local hydrologic records alone.

The maximum known flood on the Nolichucky River occurred on May 21, 1901. It had an estimated peak discharge of 120,000 cubic feet per second at the Embreeville, Tennessee, USGS stream gage located approximately

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1. Prepared by Flood Control Branch.

5.5 miles downstream from Erwin. At Poplar, North Carolina, about 12 miles upstream from Erwin, the 1901 flood is estimated to have had a peak discharge of 93,000 cubic feet per second.

One of the highest floods in recent years on North Indian and South Indian Creeks occurred in March 1965 with estimated peak discharges at their mouths of approximately 3,300 and 8,000 cubic feet per second, respectively.

It is reasonable to expect that greater floods than those of the past will occur on these streams.

Observed Storms

Observed storms are meteorologically transposable to the Erwin area from within a broad region extending generally from Oklahoma and Nebraska to the Appalachian Divide and from the Great Lakes to the middle of Mississippi, Alabama, and Georgia. The moisture source for storms in this region is the warm, moist air flowing northward from the tropical Atlantic Ocean. In general the moisture potential for a given region decreases with its increased distance from the moisture source. Transposition of storms from within the broad region includes adjustments for the particular meteorological conditions to be expected in the Erwin area.

Table 16 lists known rainfall depths for several large storms transposable to this area.

TABLE 16

SELECTED MAXIMUM OBSERVED STORMS TRANSPOSABLE

TO THE REGION OF ERWIN, TENNESSEE

Date	Location	Drainage Area sq. mi.	Rainfall Duration hours	Rainfall Depth inches
September 1926	Iowa	60	6	13.5
		800	12	11.2
July 1939	Kentucky	25	3	18.3
September 1940	Oklahoma	60	6	15.7
		800	12	14.1
July 1942	Pennsylvania	60	6	18.7
		800	12	11.3
August 1943	West Virginia	25	3	10.2
June 1944	Nebraska	800	12	9.9

Upon the basis of these and other data, as adjusted for conditions at Erwin, the following rainstorms were adopted for computing the Maximum Probable Floods:

Location	Drainage Area sq. mi.	Rainfall Duration hours	Rainfall Depth inches
Nolichucky River			
Lower Limit (Mile 92.7)	791	12	11.9
Upper Limit (Mile 98.3)	636	12	12.5
North Indian Creek			
Mouth	59.3	4	11.0
Upper Limit (Mile 9.4)	23.6	2	8.7
South Indian Creek			
Mouth	81.0	4	10.4
Upper Limit (Mile 4.2)	72.5	4	10.8

From a meteorological standpoint, storms 1.5 times greater than these can occur.

Observed Floods

Factors such as the meteorology of the region and flood-producing characteristics of the watershed were given consideration in determining whether peak discharges on other streams are applicable. Tables 14 and 17 list peak discharges for observed floods on several streams of approximately the size of those discussed in this report. For comparison, the discharges of the maximum known floods on the streams included in this study are listed.

TABLE 17

SELECTED MAXIMUM OBSERVED FLOODS

APPLICABLE TO ERWIN, TENNESSEE

Stream	Location	Drainage Area sq. mi.	Date	Peak Discharge Amount cfs	Peak Discharge Per Sq. Mile cfs
E. F. Globe Cr.	Lewisburg, Tenn.	6.6	1939	16,300	2,470
Dutch Creek	Valle Crucis, N. C.	10.6	1940	16,000	1,510
Charles Creek	Faulkner Spr., Tenn.	32.0	1952	23,000	720
Triplett Creek	Morehead, Ky.	47.5	1939	44,000	926
Elk Creek	Elkville, N. C.	50.0	1940	70,000	1,400
Whites Creek	Glen Alice, Tenn.	123	1929	66,000	537
Doe River	Elizabethton, Tenn.	137	1901	25,000	182
Watauga River	Stump Knob, Tenn.	171	1940	50,000	292
Caney Fork	Butts Bridge, Tenn.	375	1929	94,000	251
North Indian Creek	Unicoi, Tenn.	32.7	1965	1,200	37
North Indian Creek	Erwin, Tenn.	57.3	1965	3,100	54
South Indian Creek	Erwin, Tenn.	76.9	1965	8,000	104
Nolichucky River	Poplar, N. C.	608	1901	93,000	153
Nolichucky River	Erwin, Tenn.	727	1901	109,000	150
Nolichucky River	Embreeville, Tenn.	805	1901	120,000	149

Maximum Probable Flood Discharges

From consideration of the flood discharges in Tables 14 and 17, and of the transposition to the Erwin area of outstanding storms, the peak discharges of the Maximum Probable Floods at selected locations on the streams included in this study are listed in Table 18.

TABLE 18

MAXIMUM PROBABLE FLOOD PEAK DISCHARGES

Stream	Location	River Mile	Drainage Area sq. mi.	Discharge cfs
Nolichucky River	Above North Indian Creek	94.1	727	190,000
	Above South Indian Creek	95.6	639	180,000
North Indian Creek	Tennessee Highway 81	1.22	57.3	43,000
	U. S. Highway 19W & 23	6.75	32.7	34,000
South Indian Creek	Bridge at Shallowford Church	3.14	76.9	54,000

Frequency

It is not possible to assign a probability of occurrence or frequency to the Maximum Probable Flood. The occurrence of such a flood would be a rare event; however, it could occur in any year.

Possible Larger Floods

Floods larger than the Maximum Probable are hydrologically possible; however, the combination of factors that would be necessary to produce such floods would seldom occur. The consideration of floods of this magnitude is of greater importance in some problems than in others but should not be overlooked in the study of any problem.

HAZARDS OF GREAT FLOODS

The amount and extent of damage caused by any flood depend in general upon how much area is flooded, the height of flooding, the velocity of flow, the rate of rise, and the duration of flooding.

Areas Flooded and Heights of Flooding

The areas flooded by the Maximum Probable Floods and the 1901 or 1965 floods are shown on Plates 7 to 10. Depths of flow can be estimated from the crest profiles which are shown on Plate 11.

The profiles for the three streams were computed by using stream characteristics for selected reaches as determined from observed flood profiles, topographic maps, and valley cross sections which were surveyed in 1966.

The elevations shown on Plate 11 and the overflow areas shown on Plates 7 to 10 have been determined with an accuracy consistent with the purposes of this study and the accuracy of the basic data. More precision would require costly surveys not warranted by this study.

The profiles of the Maximum Probable Floods depend in part upon the degree of destruction or clogging at various bridges during the flood. Because it is impossible to forecast these events, it was assumed that all structures would stand and that no clogging would occur.

The Maximum Probable Flood profile on the Nolichucky River varies from about 2 to 14 feet above the largest flood of record, May 1901. The greatest difference is immediately above the old U. S. Highway 19W & 23 bridge at Mile 97.4 and results from heading up at the bridge. At Erwin, the Maximum Probable Flood profile is about 6 feet higher than the maximum known flood.

The Maximum Probable Flood profile on North Indian Creek is from about 3 to 19 feet higher than elevations experienced in the March 1965 flood. The maximum difference occurs upstream from the bridge at Mile 8.85, and is the result of heading up at the bridge and the narrow overflow plain.

On South Indian Creek the Maximum Probable Flood profile is from 6 to 16 feet higher than elevations experienced during the March 1965 flood. The maximum difference occurs upstream from the road bridge at Mile 1.38 and is principally the result of heading up at the bridge.

Figures 9 to 15 on pages 59 to 62 show the height that would be reached by the Maximum Probable Flood at several locations in the vicinity of Erwin.

Velocities, Rates of Rise, and Duration

Water velocities in the streams during a flood depend largely upon the size and shape of the cross section, the condition of the stream, and the bed slope, all of which vary on the different streams and at different locations on the same stream.

During the Maximum Probable Flood, velocities in the main channels of Nolichucky River, North Indian Creek, and South Indian Creek would range from about 4 to more than 15 feet per second. In the overflow areas velocities would range from about 2 to 8 feet per second.

The total rise above low water to the crest stage, the maximum rate of rise, and the duration above bankfull stage of the Maximum Probable Flood on each of these three streams would be as shown in Table 19.

These rapid rates and high stream velocities in combination with deep, long-duration flooding would create a hazardous situation in developed areas.

TABLE 19

MAXIMUM PROBABLE FLOODS--RATE OF RISE AND DURATION

Stream	Location	Total Rise above Low Water	Maximum Rate of Rise	Duration above Bankfull Stage
Nolichucky River	Below U. S. Highway 19W & 23 bridge, Mile 95.90	31 feet in 15 hours	4 feet in 1 hour	44 hours
North Indian Creek	Below Tenn. Highway 81 bridge, Mile 1.22	18 feet in 7 hours	4 feet in 1 hour	34 hours
South Indian Creek	At county bridge, Mile 0.34	22 feet in 8 hours	7 feet in 1 hour	31 hours

Excerpts from EAs/FONSIs regarding Floodplains

Sources: TVA , NRC EA/FONSIs, DOE 1996 EIS and and ROD, DOE 2007 SA1, NFS LARs and Supplemental Environmental Report, 1967-Present

March 1967 - Floods on the Nolichucky River and North and South Indian Creeks in the Vicinity of Erwin, Tennessee (TVA, Division of Water Control Planning). "In the vicinity of Erwin the flood-plain elevation is between 1,600 and 1,700 feet (page 9). Downstream from the Riverview section near the mouth of Martin Creek are located the buildings of Nuclear Fuel Services, Inc. They are above the level of the Regional Flood, but are 3 to 6 feet below the Maximum Probable Flood (page 16)."

August 13, 1991 - EA/FONSI, NFS SNM-124 Renewal. Affected Environment: Page 3-1, "The developed portion of the site is about 9 m (30 ft) in elevation above the nearest point on the Nolichucky River (0.3km (0.2 mile) northwest of the plant."). (ML050210220).

June 1996 - DOE, Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement, pages 4-53 and 4-54, Nuclear Fuel Services, Surface Water.
Page 4-54 - "The site has the potential for being flooded if the Nolichucky River experiences very high flows. Elevations of the building floors are between 500 and 510 m (1,640 and 1,670 ft). **The UF6 conversion and blending facility would not be accommodated at facilities in the 300 Area, located *inside* the 100 or 500-year floodplain**. (Text deleted)." (emphasis added).

August 5, 1996 - The Record of Decision for the Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement, Federal Register, Vol. 61, No. 151, states "Of the four candidate sites, two DOE (Y-12 and SRS) and two commercial (B&W and NFS), all facilities ***except*** NFS .....would be *outside* the limits of the 100-year floodplain and are at least one foot above the 100 year floodplain elevation and, therefore would conform to both State and local floodplain requirements. **As discussed in section III.D, the potential for flooding at NFS is another relative disadvantage of that facility**." (emphasis added).

Jan. 31, 1999 - NRC EA, SNM-124 Renewal. Affected Environment: Page 3-1, "The developed portion of the site is at a distance of about 0.3 kilometer (0.2 miles) from the river. The plant elevation is about 9 meters (30 feet) above the nearest point on the Nolichucky River." (ML05060028).

Nov. 9, 2001 - NFS Supplemental Environmental Report for Licensing Actions to support the Blended Low-enriched Uranium Project at Nuclear Fuel Services.
Page 3-3, paragraph 3.4.4, Flood Plains, Streams and Marshes.

"In 1997, Dewberry and Davis consulting engineers performed an analysis of the Martin Creek flood plain incorporating the modified culvert (under CSX Transportation rail yard) dimensions (DEW 1997). The result of the analysis indicated an increase in the flood plain levels of 0.4 feet. Northern sections of the NFS property remain in the 100-year flood plain. The updated map indicates the flood plain boundary is at the northern wall of the BPF (Building redacted - Bldg 333) (BLEU Preparation Facility)."

"In May 2000, Tysinger, Hampton and Partners, Inc. on behalf of the Town of Erwin submitted to the Federal Emergency Management Agency (FEMA) an application for a Letter of Map Revision (LOMR) for a portion of Martin Creek that borders the north slope of NFS property. FEMA updated the Flood Insurance Study, Flood Insurance Rate Map and Flood Boundary and Floodway Map along Martin Creek (FEMA 2001)."

"Banner Spring and Banner Spring Branch are located entirely on NFS property. Banner Spring Branch is being relocated to a culvert as part of the decommissioning effort. Banner Spring Branch empties to Martin Creek, which flows along the northern border of the site." (ML050130093).

June 30, 2002 - NRC Environmental Assessment for Proposed License Amendment to SNM-124 regarding Downblending and Oxide Conversion of Surplus High-Enriched Uranium. Affected Environment: Page 3-1, "The developed portion of the site is about 0.3 km (0.2 mi) from the river. The plant elevation is about 9 m (30 ft) above the nearest point on the Nolichucky River." (ML050540096).

September 17, 2003 - EA/FONSI for License Amendment Request dated October 11, 2002, Blended Low-enriched Uranium Preparation Facility (BPF). Affected Environment: Page 3, "The plant elevation is about 9 m (30 ft) above the nearest point on the Nolichucky River." (ML032390428)

June 14, 2004 - EA/FONSI for License Amendment Authorizing Operations at the Oxide Conversion Building and the Effluent Processing Building at the Blended Low-enriched Uranium Complex. Affected Environment: Page 7, "The plant elevation is about 9 m (30 ft) above the nearest point on the Nolichucky River." (ML041470176).

August 31, 2007 - NFS License Amendment Request for Processing UF6 in the CD Line Facility at the NFS Site, (ML073090651). The first paragraph of the letter from NFS to the NRC states, "Nuclear Fuel Services, Inc. (NFS) hereby requests an amendment to the referenced license to authorize processing of special nuclear materials in the form of UF6 in the CD Line (CDL) Facility (Building 301) at the NFS Site."

October 25, 2007 - EA/FONSI related to Proposed License Amendment authorizing Increased Possession Limit. Affected Environment: Page 4, "The plant elevation is about 9 m (30 ft) above the nearest point on the Nolichucky River." (ML072250413).

August 15, 2008 - EA/FONSI for Proposed License Amendment authorizing the Processing of Uranium Hexafluoride in a New Process Line at Nuclear Fuel Services, Erwin, Tennessee. Affected Environment: Page 4, "The plant elevation is about 9 m (30 ft) above the nearest point on the Nolichucky River." (ML082290438).

NOTE: In summary, every NRC EA/FONSI regarding NFS license amendments, the 1996 DOE-EIS-0240, and the DOE-EIS-0240-SA1, have all failed to admit the truth regarding the extent of the Nolichucky floodplain. According to the 1996 EIS, Building 301, where the UF6 will be processed, is in the 100-500-year floodplain. By perpetually quoting incorrect data -- and cutting and pasting the exact same misleading sentence into at least 6 EAs that we know of -- the NRC further deludes the public and continues to fail to recognize the danger of having extremely volatile material in a flood zone.

Johnson City Press
Empowering People Through the Press

Story Published on Friday, September 17, 2004

Click here to print this story (Macintosh users, please press Cmd + P on your keyboard to print story.)

Raging river causes damage to Linear Park

ERWIN — You'd never know by the calmness of the Nolichucky River Wednesday afternoon that the raging river caused considerable damage last week to Erwin's popular Linear Park and other properties along the river in Unicoi County.

Mayor Russell Brackins, who estimated the park's damage at nearly $40,000, said the town would fix the park back "and you'll never know this happened." Brackins said he would investigate whether grant funds for the repair and cleanup are available.

Brackins said city staff estimates placed the damage at $30,000 to $40,000 to repair the trail.

"If grant funds aren't available, then we'll fund the project through other means. We'll repair the existing trail, whatever it takes," he said.

A lone fisherman was busy casting for trout and bass amid a backdrop of fallen trees, while craters filled with mud along the trail provided plenty of evidence of the power of the Nolichucky when it floods.

"It's never been like this since the big flood of 1977," said Public Works Director Carroll Mumpower. "We had a flood a year ago and the area where we are standing was under water, but the park didn't receive any major damage. We are going to wait to see what the next hurricane (Ivan) does because it's no use doing work if we are going to be in the middle of another mess."

Mumpower and Public Works employee Ed Crowe were busy posting additional warning signs at the park Wednesday.

"Basically, we are making sure this part of the park is not used until we get it fixed," he said. "The rest of the park is fine." Hundreds of walkers and runners use the park everyday.

"At (the trail near) McDonald's, if you're down there at 6 p.m., you'll see hundreds using the trail," Mumpower said. "It is really amazing how much it is used."

The trail, which runs through a large portion of Erwin, was funded with state grant money, and the town has been singled out for the project that has become a construction model for other cities to follow. In fact, plans are in the works to take the trail to Iron Mountain on one end of Erwin to the Appalachian Trail spur near the Chestoa community on the other end of town.

The park's damage occurred adjacent to Outriggers in the county's Industrial Park. Extensive damage also was caused to numerous properties along the Nolichucky through Unicoi County to the North Carolina line, due to runoff and the river's height after the remnants of Hurricane Francis dumped a foot of rain on the region last week.

Farmland in Unicoi County has begun to dry out after the last few days of sunshine and temperatures in the 80s. However, farmers were reporting water damage to crops throughout the county.

"We just don't need anymore rain right now," one local farmer said. "It was a mess last week, and we still haven't recovered. But I see on the news we may be getting it again this weekend."

Johnson City Press

Empowering People Through the Press

Story Published on Thursday, October 14, 2004

Click here to print this story (Macintosh users, please press Cmd + P on your keyboard to print story.)

Erwin seeks FEMA funds to repair trail

ERWIN — In an effort to rebuild Erwin's popular Linear Walking Trail and several county roads damaged by recent flooding, Unicoi County will seek about $100,000 from the Federal Emergency Management Agency, Ed Herndon, director of Unicoi County's Emergency Management Department, said Wednesday.

Erwin Mayor Russell Brackins has requested about $90,000 on behalf of the city to immediately rebuild the Linear Trail Park, which was damaged by two floodings of the Nolichucky River near Bear Mountain Outfitters. The flooding came about after the remains of Hurricanes Frances and Ivan passed through the area.

Every day, hundreds walk the trail that meanders through Erwin, beginning behind McDonald's restaurant.

"As you know, we sustained a considerable amount of flood damage. We have assessed the damage, which was extensive. In the past when the Nolichucky River would overflow, we would get some mud and tree limbs washed onto the trail, but this time the two back-to-back floods took away the park's infrastructure, and it will be a tremendous job to refurbish it and get it back to normal," Brackins said Wednesday.

"I can assure everyone that the damage will be addressed and the construction will get done as quickly as possible. We have already addressed flood damage and have corrected problems in the Rock Creek and Martins Creek communities through funds from existing grants the city received. The work done in those areas was mitigated in such a way as to address future flooding," he added.

"Other monies to rebuild county roads will be funded at 75 percent of the reimbursement cost," Herndon said. "Since we had no homes damaged, individuals are not eligible for FEMA aid."

Herndon said Unicoi County farmers who experienced damaged crops or damaged farmland should contact the local U.S. Department of Agriculture office for federal aid forms. Low-interest emergency loans and other possible assistance is available through USDA, Herndon said.

Brackins said a few city streets were damaged and the town addressed the need for culvert and shoulder work on damaged roads to thwart the possibility of future flooding.

"We have already addressed those items and paid for the work through normal

budget procedure within the city's street department," he said.

"We added flood control measures when we addressed the flooding problems in the Rock Creek and Martins Creek communities," Brackins said. "I don't foresee future flooding problems in those areas since we addressed the flooding problems by adding rock, wire mesh drainage measures and rip-rap."

Herndon said his office had reviewed all damaged areas in Unicoi County and cost estimates will be tabulated before a final request for funding is prepared.

"As of now, we aren't on the list for FEMA funding, but I do understand it looks good that we will be added to the list after the proper paperwork is completed," he said.

Johnson City Press, Page 5A

LOCAL/TENNESSEE Nov. 22, 2008

Quake study shows Tenn. would suffer great shakes

THE ASSOCIATED PRESS

In Tennessee, the study predicts 250,000 buildings would be moderately or more severely damaged, more than 260,000 people would be displaced and well over 60,000 casualties would be expected. In the state alone, the direct economic losses would surpass $56 billion.

MEMPHIS — A new federal study predicts Tennessee would see the highest level of damage if a major earthquake were to shake the New Madrid Seismic Zone in the southern and central part of the country.

The Federal Emergency Management Agency released the two-year study this week as part of the Catastrophic Earthquake Disaster Response Planning Initiative. Besides Tennessee, the seismic zone includes areas of Alabama, Arkansas, Illinois, Indiana, Kentucky, Mississippi and Missouri.

The study predicted that the total economic impact of a series of earthquakes along the New Madrid fault was likely to be "by far the highest economic loss due to a natural disaster in the USA."

The report included state-specific scenarios such as damage levels to buildings, highway bridges, electric power, drinkable water, waste water, communications facilities and pipelines from a 7.7 magnitude quake. On the Richter scale, an earthquake with a magnitude of 7 and above is deemed "major," capable of widespread, heavy damage.

In Tennessee, the study predicts 250,000 buildings would be moderately or more severely damaged, more than 260,000 people would be displaced and well over 60,000 casualties would be expected. In the state alone, the direct economic losses would surpass $56 billion.

The report is intended to give state and local emergency agencies information to create disaster response plans.

While the central U.S. is not typically considered a seismically active region, the fault line there has a dangerous history. During the winter of 1811 and 1812, a series of three earthquakes, with magnitudes of around 8, struck northeast Arkansas and southeast Missouri.

The quakes caused massive landslides along Mississippi and Ohio River bluffs from Memphis to Indiana and created gaping crevices and fissures. Few written accounts exist about the early quakes, but reports said they were strong enough to awaken sleepers in Washington, D.C.

The U.S. Geological Survey estimates a 7 to 10 percent chance of an earthquake similar in intensity in the next 50 years.

The Memphis and St. Louis areas were identified as likely to sustain damage from a major earthquake.

REPORT TO CONGRESS ON ABNORMAL OCCURRENCES
FISCAL YEAR 1998

NUCLEAR POWER PLANTS

Using the criteria and guidelines in Appendix A to this report, none of the events that occurred at U.S. nuclear power plants during this reporting period was determined to be significant enough to be reported as an abnormal occurrence (AO) in this reporting period.

FUEL CYCLE FACILITIES
(Other than Nuclear Power Plants)

Using the criteria and guidelines in Appendix A to this report, one event that occurred at a fuel cycle facility during this fiscal year was determined to be significant enough to be reported as an AO in this reporting period:

98-1 Seismic Risk from Liquid Uranium Hexafluoride at the Withdrawal Facilities at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky.

The following information pertaining to this event is also being reported concurrently in the *Federal Register*. Appendix A (see Part III, "For Fuel Cycle Facilities") to this report states that a major condition or significant event not considered in the license/certificate that requires immediate remedial action will be considered for reporting as an AO.

Date and Place — February 18, 1998; Paducah Gaseous Diffusion Plant, a uranium enrichment plant, operated by Lockheed Martin Utility Services for the United States Enrichment Corporation (USEC) and located about 16 kilometers (10 miles) west of Paducah, Kentucky.

Nature and Probable Consequences — On October 31, 1997, USEC submitted a certificate amendment request that provided an updated Safety Analysis Report, containing a new accident analysis, for Paducah. The seismic accident analysis stated that equipment (piping, condensers, and accumulators) in the withdrawal facilities containing liquid uranium hexafluoride (UF_6) could fail at a 70-year return earthquake [0.05 gravitational acceleration (g) peak ground acceleration (pga)] rather than at the 250-year return design basis earthquake (0.15 g pga). However, the consequences of the accident analysis were noted as minimal because of the assumptions made in the accident analysis. The NRC's request for additional information (RAI) dated February 5, 1998, raised concerns about the conservative nature of assumptions for the seismic accident analysis. In response to the RAI, USEC confirmed that the seismic accident analysis assumption of no liquid UF_6 in the withdrawal facilities' accumulators underestimated the potential source term for the seismic accident analysis.

The accumulators are normally empty and serve only as a reservoir for liquid UF_6 when cylinders are changed after being filled, or during periods of equipment problems or surveillances. However, with no operational restrictions on the amount of liquid UF_6 in the accumulators, a seismic event could occur with the accumulators full. Consequences from a 0.05 g pga earthquake with full accumulators in the withdrawal facilities could involve onsite fatalities and significant offsite injuries from exposure to the released UF_6 and reaction products.

Cause or Causes — The cause of this event was an inadequate seismic design for the facility and an inadequate accident analysis that failed to consider the full range of allowable operations of the withdrawal facilities.

Actions Taken To Prevent Recurrence

Licensee/Certificate Holder — Immediate corrective actions included restricting operations in the withdrawal facilities to limit the amount of liquid UF_6 available for release. Long-term corrective actions were to install seismic modifications that will allow the withdrawal facilities' equipment to withstand a design-basis earthquake. The modifications have been completed as directed by the NRC.

NRC — An immediately effective "confirmatory order modifying certificate" to incorporate the immediate and long-term corrective actions was issued on April 22, 1998.

This event is closed for the purpose of this report.

* * * * * * * *

OTHER NRC LICENSEES

(Industrial Radiographers, Medical Institutions, Industrial Users, etc.)

Using the criteria in Appendix A to this report, the following events that occurred at facilities licensed or otherwise regulated by NRC during this reporting period were determined to be significant enough to be reported as abnormal occurrences (AOs):

98-2 Multiple Medical Brachytherapy Misadministrations by José N. De León, M.D., in Rio Piedras, Puerto Rico

The following information pertaining to this event is also being reported concurrently in the *Federal Register.* Appendix A (see Criterion IV, "For Medical Licensees") to this report states that a medical misadministration that results in a dose that is (1) equal to or greater than 1 gray (Gy) (100 rad) to a major portion of the bone marrow, to the lens of the eye, or the gonads, or (2) equal to or greater than 10 Gy (1000 rad) to any other organ and that represents a dose or dosage that is at least 50 percent greater than that prescribed in a written directive will be considered for reporting as an AO.

Date and Place — Between April 27, 1995, and June 26, 1996; private medical office of José N. De León, M.D., Rio Piedras, Puerto Rico

Nature and Probable Consequences — Nine patients were treated after surgery for non-malignant eye growths with a strontium-90 (Sr-90) eye applicator, at Dr. De León's private medical office. Each of the nine patients received a dose of 4000 centigray (cGy) (4000 rad) instead of the intended dose of 2000 cGy (2000 rad). The NRC staff identified this event during Fiscal Year 1998.

On June 1, 1994, Dr. De León submitted to NRC a Quality Management Program (QMP) indicating that his 4.625 gigabecquerel (125 millicurie) Sr-90 eye applicator device would deliver to a patient a dose of 2000 cGy (2000 rad) in 26 seconds. In April 1995, Dr. De León hired a health physics consultant to calculate a decay correction for the surface dose rate of the Sr-90

March 12, 2008

The Honorable Gregg Lynch, Mayor
County of Unicoi
P.O. Box 169
Erwin, TN 37650

SUBJECT: RESPONSE TO CONCERNS REGARDING THE DEPARTMENT OF ENERGY SUPPLEMENT TO THE ENVIRONMENTAL IMPACT STATEMENT FOR THE DISPOSITION OF SURPLUS HIGHLY ENRICHED URANIUM (DOE/EIS-0240-SA1)

Dear Mayor Lynch:

We wish to thank you for bringing the concerns of your constituents to our attention during our meeting at Nuclear Fuel Services (NFS) on February 28, 2008. As promised during the public meeting, we contacted the U.S. Department of Energy (DOE) to clarify statements in the "Supplement Analysis for the Disposition of Highly Enriched Uranium" (DOE/EIS-0240-SA1) dated October 2007.

DOE has informed us that the "1 chance in 71" estimate refers to the risk of a single latent cancer fatality in the entire population living within 50 miles of NFS based on one year of operation. This meaning could have been explained better. We regret the concerns the estimate has caused. NRC staff has reviewed the report and believes that the risk may be clearer when expressed as follows: The exposure of the entire population within 50 miles of NFS, to the annual doses estimated by DOE, for a period of 71 years, would be expected to result in no more than 1 cancer death in the entire population. Please note that the actual releases from NFS are much less than those used in the calculation.

In terms of individual risk, the population risk of 1 chance in 71 translates to an individual risk of 1 chance in 85 million of developing cancer as a result of downblending operations at NFS. This risk is consistent with an environmental assessment conducted by NRC in 2002. It is less than the risk of a person being struck by lightning which is about 1 in a million.

Should you have any questions concerning this letter, please contact Kevin M. Ramsey of my staff at 301-492-3123. We intend to schedule a public meeting in the near future to address this matter and any additional questions.

Sincerely

/RA/

Robert C. Pierson, Director
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards

Docket No. 70-143
License No. SNM-124

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THE ERWIN RECORD
VIEWPOINT
MARCH 25, 2008, PAGE 4-A

Explanations add up to big fat zero

FROM THE PUBLISHER'S DESK

By Mark A. Stevens

NFS: Nuclear Fuel Services.

NNSA: National Nuclear Security Administration.

DOE: Department of Energy.

NRC: Nuclear Regulatory Commission.

ECAN: Erwin Citizens Awareness Network.

IDK: I Don't Know.

LOL: Laugh Out Loud.

I figure I might as well get all the acronyms out of the way at the very beginning. It's confusing enough, peppered through a newspaper article.

Don't feel bad if you've been more than a little confused after reading the last two weeks of coverage about NFS and a report from NNSA.

First, there are way too many acronyms involved – NFS, the NRC, the NNSA, the DOE and ECAN, to name the top five. It's about as confusing to me as the "cyber"speak folks communicate with today on their iPhones, Blackberries and other digital devices – all machines smarter than I am.

If you've kept up with the NFS story, you probably know the gist of it: a footnote in a now-controversial NNSA report seemed to suggest that downblending operations at NFS could cause a fatal cancer in one out of every 71 people living in a 50-mile radius of the Erwin plant.

What it really says, apparently, is that one in 85 million could develop a fatal cancer.

The whole thing has been as clear as mud, and, truthfully, NFS has received a bad rap throughout the whole thing.

Surprisingly, NFS' troubles stem less from ECAN and the Sierra Club, both of which have expressed concerns about the report, than from the organizations one would expect to offer some clear understanding of the situation.

That's not been the case. In fact, the NNSA, the NRC and the DOE's efforts to explain what the report meant in the first place has become confusing and muddled.

No one seems to be able to properly explain the one-in-85-million figure. That

Please see ZERO, Page 5-A

Continued from Page 4-A

doesn't mean that it's wrong. It simply means that once you try to explain the use of a number that for all practical purposes equals zero, you've got more explaining to do than if you had just said it in simple English the first time around.

NNSA says that its one-in-71 footnote was meant to convey that there is a one chance in 71 that one additional person out of the 1.28 million people living within 50 miles of NFS would die from a fatal cancer over their lifetime.

A few days after the NNSA came out with that clear-as-mud explanation, the NRC decided it would take its own stab at explaining what a zero chance actually meant in the way of numbers.

The NRC decided to add 71 years to the equation, saying it was still one in 85 million. That is, if you didn't pay attention to another correlation listed for the chances of getting cancer. The NRC said the chances would be akin to your chances of being struck by lightning, which is about one in a million.

Later, Kevin M. Ramsey, a senior project manager at the NRC, admitted that "maybe we're causing more problems trying to explain it this way."

Now that's a clear statement.

Last Monday, the NNSA said the NRC's explanation wasn't "accurate," but on Tuesday morning, even the NNSA had changed its mind, saying that the NRC, in its own clumsy way, was essentially correct.

Really? Again, thanks for clearing that up.

The NNSA, the NRC and the DOE are made up of a lot of very smart people – scientists, physicists, mathematicians, to name but a few, but they sure do have a hard time explaining when their own math adds up to a big fat zero.

IDK about you, but I bet officials at NFS might say that with friends like the NNSA, NRC and the DOE, who needs enemies?

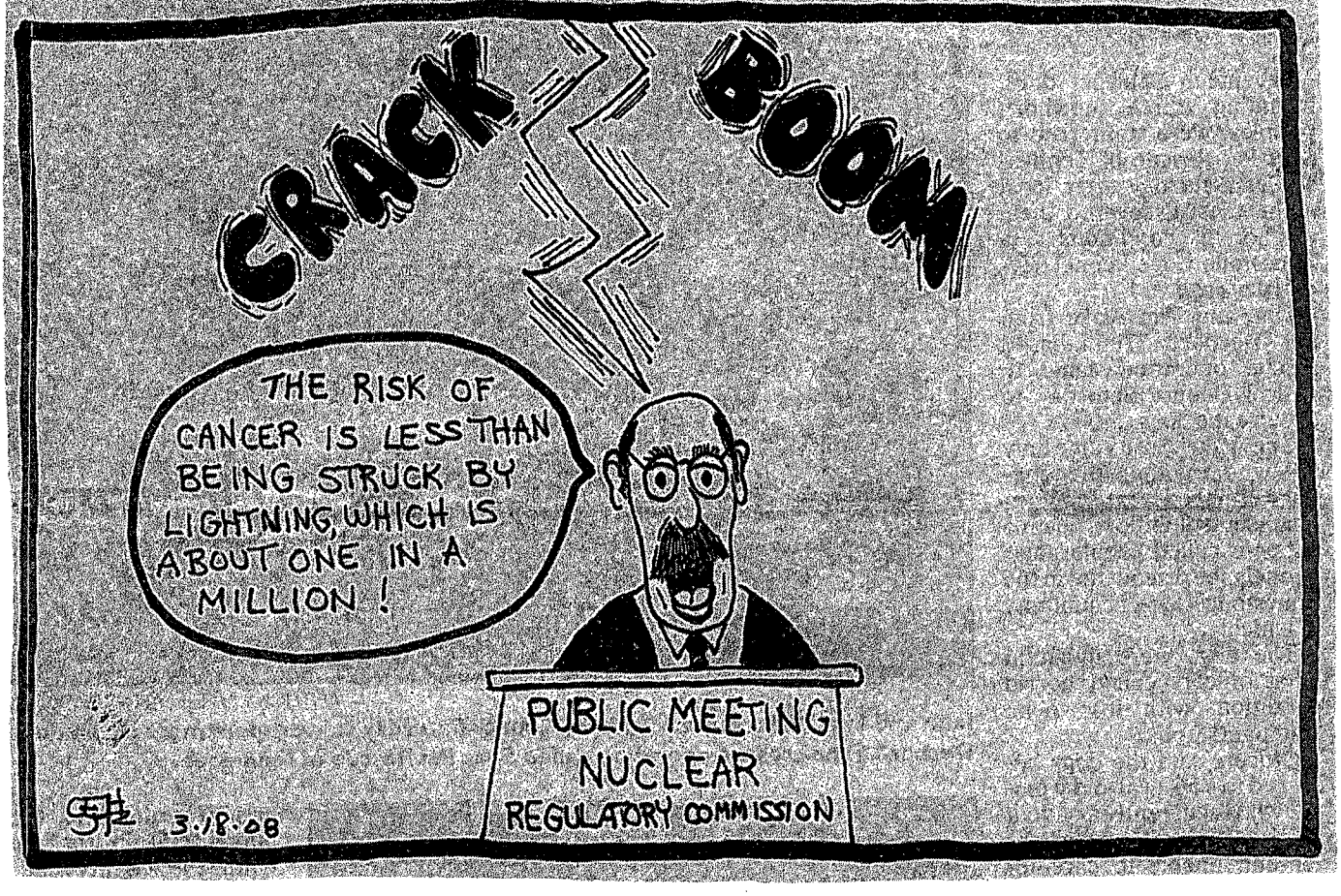
You've got to admit that if all this didn't surround such a serious subject, it'd be downright funny. Oh, who am I kidding? Go ahead, LOL.

Chances are just about zero that you can't help but laugh at these people.

THE ERWIN RECORD

viewpoint

ON THE DRAWING BOARD with Charles E. Holt Jr.



September 11, 2007:

The Honorable Christopher Shays:
Ranking Member, Subcommittee on National Security:
and Foreign Affairs:
Committee on Oversight and Government Reform:
House of Representatives:

Subject: Nuclear Security: DOE and NRC Have Different Security Requirements for Protecting Weapons-Grade Material from Terrorist Attacks:

Dear Mr. Shays:

In terrorists' hands, weapons-grade nuclear material--known as Category I special nuclear material when in specified forms and quantities--can be used to construct an improvised nuclear device capable of producing a nuclear explosion. Responsibility for the security of Category I special nuclear material is divided between the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC). Specifically, DOE and the National Nuclear Security Administration (NNSA), a separately organized agency within DOE, are responsible for overseeing physical security at government-owned and contractor-operated sites with Category I special nuclear material. NRC, which is responsible for licensing and overseeing commercially owned facilities with nuclear materials, such as nuclear power plants, is responsible for regulating physical security at those licensees that store and process Category I special nuclear material under contract, primarily for DOE.

Because of the risks associated with Category I special nuclear material, both DOE and NRC recognize that effective security programs are essential. The key component in both DOE's and NRC's security programs is each agency's design basis threat (DBT)--classified documents that identify the potential size and capabilities of terrorist threats to special nuclear material. To counter the threat contained in their respective DBTs, both DOE sites and NRC licensees use physical security systems, such as alarms, fences, and other barriers; trained and armed security forces; and operational security procedures, such as a "two-person" rule that prevents unobserved access to special nuclear material. In addition, to ensure DBT requirements are being met and to detect potential security vulnerabilities, DOE and NRC employ a variety of other measures, including inspection programs; reviews; and force-on-force performance tests, in which the site's security forces undergo simulated attacks by a group of mock terrorists.

Over the past several years, we have raised concerns about certain aspects of security at DOE sites and at NRC-regulated commercial nuclear power plants. For example, we reported that DOE had taken some action in response to the terrorist attacks of September 11, 2001, but that it needed to improve the management of its security program.[Footnote 1] In addition, we found that DOE needed to fully implement security improvements initiated in response to its DBT, such as the consolidation of special nuclear material and the development of a better-trained and -organized security force, in order to ensure that its sites were adequately prepared to defend themselves.[Footnote 2]

Regarding NRC, in September 2003, we reported that NRC's oversight of security at commercial nuclear power plants needed to be strengthened.[Footnote 3] In March 2006, we reported that commercial nuclear power plants had upgraded security against terrorist attacks, and NRC had improved its force-on-force inspections at these plants. However, we found that NRC's DBT process, as it is applied to commercial nuclear power plants, should be improved to remove the appearance that changes to the DBT were based on what the nuclear industry considered feasible to defend against rather than on an assessment of the terrorist threat itself.[Footnote 4] While NRC has a more rigorous DBT for its licensees that store and process Category I special nuclear material than it does for the commercial nuclear power plants that it licenses and regulates, NRC uses a similar DBT development process for both sets of licensees.

In this context, you asked us to determine (1) whether DOE's and NRC's requirements for protecting Category I special nuclear material from terrorist threats differ from one another; (2) the reasons for any differences between these requirements; and (3) if, as a result, there are differences between how NRC-licensed facilities that store and process Category I special nuclear material and how DOE facilities that store and process Category I special nuclear material are defended against a terrorist attack. In February 2007, we reported to you on the results of our work in a classified report.[Footnote 5] Subsequently, you asked us to provide you with an unclassified summary of our report. This report provides the unclassified summary. We conducted our work for this report between May 2007 and September 2007 in accordance with generally accepted government auditing standards.

In summary:

Historically, DOE and NRC have sought comparability in their respective DBTs because DOE sites and NRC licensees often deal with the same types of Category I special nuclear material. For example, in 2000, NRC imposed additional security requirements on its licensees because, as it stated at the time, NRC is responsible for ensuring that weapons-usable material in the commercial sector receives protection comparable with that provided to similar DOE material. Following the September 11, 2001, terrorist attacks, both DOE and NRC put in place more demanding DBTs. NRC issued its most recent DBT in 2003, and DOE issued its most recent DBT in 2005. More importantly, even though DOE's sites and NRC's licensees store and process similar weapons-grade nuclear material, the DBTs each agency adopted for Category I special nuclear material are different.

Several factors have contributed to the differences between DOE's and NRC's DBTs. First, a key document used in the development of DOE's DBT was the Postulated Threat to U.S. Nuclear Weapon Facilities and Other Selected Strategic Facilities (Postulated Threat). The Postulated Threat is developed by the U.S. intelligence community, principally the Department of Defense's Defense Intelligence Agency, and the security organizations of several different agencies, including DOE and NRC. The most recent Postulated Threat, issued in 2003, identified, among other things, the most likely threats to U.S. facilities with Category I special nuclear material. While NRC participated in the development of the Postulated Threat, NRC believes that the Postulated Threat does not

apply to commercial nuclear facilities such as its licensees. Second, DOE and NRC also differ in their consideration of other intelligence information in developing their DBTs. In this context, NRC has developed its DBT to be within the range of what it has determined are the limitations that a private guard force can reasonably be expected to defend against. Specifically, NRC believes that the defense against threats not contained in its DBT is the responsibility of the federal government, in conjunction with state and local governments. Finally, even though they did so in the past, since September 11, 2001, DOE and NRC have not fully cooperated in sharing classified information on potential misuse of Category I special nuclear material.

Reflecting the differences in their respective DBTs, we found differences in the actions DOE sites and NRC licensees are taking to increase their preparedness to defeat a large and sophisticated terrorist attack. For example, currently, NRC licensees do not have the same legal authority as DOE sites to acquire heavier weaponry, such as fully automatic weapons, or the same legal authority to use deadly force to protect special nuclear material. NRC is pursuing new regulations, authorized by the Energy Policy Act of 2005, to allow its licensees to use automatic weapons, but expects to take from 1 to 2 years to issue such regulations. At the same time, DOE is implementing plans that, if fully realized, will further increase security at its sites. These plans include developing and deploying improved security technologies; consolidating special nuclear material into fewer, better protected locations; and providing better training and equipment for its security forces. Finally, DOE has better developed tools for assessing security preparedness and understanding vulnerabilities, such as computer modeling and force-on-force testing programs that simulate terrorist attacks on facilities. However, NRC is in the process of adopting computer modeling and implementing a new force-on- force testing program.

A successful attack on a facility with Category I special nuclear material could have unacceptable human, economic, and symbolic consequences. Consequently, we believe that, regardless of location, there should not be differences in the protection of Category I special nuclear material. To address these differences, we made a series of recommendations in our February 2007 report, including the following:

* DOE and NRC should develop a common DBT for DOE sites and NRC licensees that store and process Category I special nuclear material.

* NRC should expedite its efforts to ensure that its licensees have the same legal authorities to acquire heavier weaponry and use deadly force as DOE sites currently have to protect such material.

* DOE and NRC should cooperate in establishing computer modeling capabilities and force-on-force performance testing programs to better assess security preparedness and detect vulnerabilities.

In addition, we recommended that Congress should consider amending the Atomic Energy Act of 1954, as amended, to give NRC licensees the same legal authority to use deadly force as DOE sites have to protect Category I special nuclear material.

We provided DOE and NRC with a draft of our February 2007 report for

review and comment. Overall, DOE, through NNSA, and NRC agreed with several of our recommendations. Specifically, both NNSA and NRC agreed to cooperate on improving force-on-force performance testing and computer modeling. NRC also agreed that obtaining legal authority to acquire heavier weapons and to clarify policies on the use of deadly force to protect Category I special nuclear material could enhance security at its licensees. NRC cited ongoing efforts in both areas. Finally, NNSA supported having Congress amend the Atomic Energy Act to provide NRC licensees with the legal authority to use deadly force to protect Category I special nuclear material. However, NNSA and NRC did not support our recommendation to develop a common DBT for facilities that store and process Category I special nuclear material. Specifically, in its comments on our report, NRC stated that it believes that it is more important to set protection levels that are appropriate for the potential scenarios that involve the malevolent use of the nuclear materials stored or handled at a given site. NRC also stated that both agencies have recognized that protection strategies may differ between the sites they oversee based on the type, form, purpose and quantity of material at their sites. However, in our evaluation of the agency's comments, we noted that all of the sites and licensees have one important thing in common--they all possess significant quantities of Category I special nuclear material. As such, we believe, there should not be differences in their level of protection.

- - - --:

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 14 days after the date of this report. We will then send copies to appropriate congressional committees, the Secretary of Energy; the Administrator, NNSA; the Chairman of the Nuclear Regulatory Commission; and the Director of the Office of Management and Budget. We will make copies of this report available to others upon request. This report will also be available at no charge on GAO's Web site at [hyperlink, http://www.gao.gov].

If you or your staff have any questions about this report or need additional information, please contact me at (202) 512-3841 or aloisee@gao.gov. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this report. James Noel, Assistant Director, and Jonathan Gill made key contributions to this report.

Sincerely yours,

Signed by:

Gene Aloise:

Director, Natural Resources and Environment:

(360882):

FOOTNOTES:

[1] GAO, Nuclear Security: NNSA Needs to Better Manage Its Safeguards

and Security Program, GAO-03-471 (Washington, D.C.: May 30, 2003).

[2] GAO, Nuclear Security: DOE Needs to Resolve Significant Issues Before It Fully Meets the New Design Basis Threat, GAO-04-623 (Washington, D.C.: Apr. 27, 2004); and Nuclear Security: DOE's Office of the Under Secretary for Energy, Science, and the Environment Needs to Take Prompt, Coordinated Action to Meet the New Design Basis Threat, GAO-05-611 (Washington, D.C.: July 15, 2005).

[3] GAO, Nuclear Regulatory Commission: Oversight of Security at Commercial Nuclear Power Plants Needs to Be Strengthened, GAO-03-752 (Washington, D.C.: Sept. 4, 2003).

[4] GAO, Nuclear Power Plants: Efforts Made to Upgrade Security, but the Nuclear Regulatory Commission's Design Basis Threat Process Should Be Improved, GAO-06-388 (Washington, D.C.: Mar. 14, 2006).

[5] GAO, (U) Nuclear Security: DOE and NRC Security Requirements for Special Nuclear Material, GAO-07-41C (Washington, D. C.: Feb. 16, 2007).

GreenevilleSun.com

Wednesday, June 01, 2005
(Last modified: 2008-03-04 00:01:57)

Source: The Greeneville Sun

A government watchdog group has recommended that U.S. storage of "bomb-grade" nuclear materials be consolidated at seven sites around the nation, including one in nearby Erwin, to boost security and save money.

In a report issued on May 19, the Project on Government Oversight (POGO) recommended that the Nuclear Fuel Services (NFS) plant in Erwin be among seven sites in the United States at which highly enriched uranium and plutonium would continue to be stored.

Currently, according to a POGO press release, 13 sites around the country house "hundreds of metric tons of plutonium and highly enriched uranium in quantities large enough to make nuclear bombs."

Among those sites, according to the POGO report, is the Nuclear Fuel Services plant in Erwin. That facility, according to the report, is one of only two commercially run facilities in the nation that store such materials.

Terrorist Threat Raised

"Security experts' greatest concern is that a suicidal terrorist group would reach its target at one of the facilities and, in an extremely short time, create an improvised nuclear bomb on site," the POGO report says.

"It is only now becoming known outside DOE (U.S. Department of Energy) how easily this could be accomplished: using a critical mass (about 100 pounds) of highly-enriched uranium, a terrorist could trigger a detonation of a magnitude close to that which devastated Hiroshima," referring to the Japanese city destroyed by a U.S. atomic bomb in 1945 near the end World War II.

"One site alone stores 400 metric tons of this material," the POGO reports says. "The possibility of this scenario was a primary motivation for the DOE's decision to significantly increase security requirements at nuclear weapons facilities last year."

NFS Discounts Report

During a telephone interview Tuesday, NFS spokesman Tony Treadway called the POGO report "speculation" and said he had heard nothing from U.S. government regulators that would lead him to believe that NFS would be designated a storage site for additional special nuclear material.

Treadway said NFS does use enriched uranium in the production of fuel for nuclear powered U.S. Navy submarines and surface ships. But he said the focus of NFS "is on processing, not storage."

NFS also is involved in "down-blending" highly enriched uranium from U.S. Department of Energy stockpiles to a low-enriched state, suitable for conversion into fuel for Tennessee Valley Authority nuclear reactors that generate commercial electric power.

Treadway also said during the telephone interview that discussion of consolidating the storage of highly enriched uranium and plutonium has been ongoing since the mid-1990s.

He also said a Department of Energy committee is expected to make a recommendation about consolidation "in 30 to 45 days."

An advisory task force to current (U.S.) Energy Secretary Samuel Bodman is scheduled to complete a report by late June, "evaluating the potential cost savings and security enhancements from consolidating the nation's

stockpiles of highly enriched uranium and plutonium," the Associated Press reported in mid-May.

But Treadway said he could not comment on what recommendations that report might contain. Once that report is issued, he said, NFS would comment, if any recommendations apply to the Erwin-based company.

The other commercial facility at which special nuclear materials are stored and used, according to the POGO report, is the Nuclear Products Division of BWXT Corp., in Lynchburg, Va.

Both NFS and BWXT "contain weapons-grade nuclear materials, (but) have not been required to meet the security standards set for similar facilities by the Department of Energy," according to the POGO report.

NFS and BWXT are overseen by the U.S. Nuclear Regulatory Commission, "which has less stringent security standards" than does the U.S. Department of Energy, according to the POGO report.

In addition, the POGO report says, security has not been tested at NFS since 1998.

NFS Data Reported

The POGO report states that the NFS complex in Erwin spans more than 60 acres and has a "21-acre protected area."

"NFS contains tons of highly-enriched uranium for the production of naval reactor fuel, and down-blends highly enriched uranium (HEU)," the Project on Government Oversight report says.

"The Nuclear Regulatory Commission (NRC) licenses this site and is responsible for testing security, but it has not tested the site's security since 1998. Although problems with security were identified at that time (1998), the Office of Naval Reactors reportedly fixed them quickly."

In October 2004, the NRC announced that this site had started down-blending 33 metric tons of highly enriched uranium from the Department of Energy's Savannah River Site to produce fuel for a Tennessee Valley Authority (TVA) nuclear power plant, the POGO report notes.

NFS Recommendations

The POGO report recommends holding the NFS facility to the same "upgraded Design Basis Threat (standards)" that apply to U.S. Department of Energy sites.

The report also recommends shifting responsibility for testing security from the NRC to the U.S. Department of Energy's Office of Safety and Security Performance Assurance.

The Project on Government Oversight's report estimates the cost of tripling the size of the security force at the NFS site to bring the facility up to Department of Energy standards to be "at least $180 million" over three years.

The report also lists as "unknown" the cost of improving the security infrastructure at NFS.

Two Oak Ridge Sites

Two other Tennessee sites where special nuclear materials are stored and used now, according to the POGO report, are the Oak Ridge National Laboratory and the Y-12 National Security Complex in Oak Ridge.

In 2004, according to the report, the U.S. Department of Energy (DOE), which oversees most U.S. facilities where "bomb-grade" nuclear materials are stored (but not the NFS plant), announced enhanced security requirements for facilities where enriched uranium and plutonium are stored.

The security enhancements, according to the POGO report, will require that 11 of the 13 existing storage sites by 2008 be able "to protect against more than triple the number of armed attackers and more lethal weapons, than did pre-9/11 standards," according to a POGO release.

As a result, the DOE security costs will increase dramatically, POGO says.

Could Be Terrorist Targets

Peter Stockton, a POGO senior investigator, said during a Tuesday telephone interview that his organization's aim is to see a reduction of the amount of highly enriched uranium being stored and to improve security for the special nuclear material that remains in storage.

"Any high school student knows what you can do with highly enriched uranium," he said.

The May 19 POGO release indicates that "interviews with experts throughout the nuclear weapons complex" have led to the conclusion that some U.S. sites no longer need to house nuclear materials.

POGO also has concluded, according to its release, that special nuclear materials, including plutonium and highly enriched uranium, should be moved to other locations.

"In addition, efforts to immobilize or down-blend excess nuclear materials would also help save taxpayer dollars," the POGO report says.

Sites Urged To be Closed

Topping the list of sites that should be immediately de-inventoried (of special nuclear material) "is Lawrence Livermore National Laboratory located outside San Francisco," according to the POGO report.

"Department officials have confirmed POGO's assertion that weapons protecting Livermore are not as lethal as they should be due to encroaching neighborhoods surrounding the facility, making it more vulnerable to an attack," a POGO release says.

Other sites needing to be immediately "de-inventoried" of highly enriched uranium and/or plutonium, according to the POGO report, include:

• the Oak Ridge National Laboratory, which has "almost no security to protect 1,000 cans of Uranium-233, an attractive material for terrorists intent on building an improvised nuclear device;"

• the Sandia National Laboratory and Los Alamos National Laboratory Technical Area 18 in New Mexico, "which have serious safety or security risks that merit speeding up existing relocation plans;" and

• the Hanford Reservation in Washington, "which failed a security exercise after 9/11 and has no plan for relocating plutonium from the Los Alamos Molten Plutonium Reactor Experiment."

POGO Described

POGO, according to its Web site, "investigates, exposes, and seeks to remedy systemic abuses of power, mismanagement, and subservience by the federal government to powerful special interests."

Founded in 1981, POGO says it is "is a politically-independent, nonprofit watchdog that strives to promote a government that is accountable to the citizenry."

February 6, 2004

NRC plans second on-site inspector for NFS

By Thomas Wilson
STAR STAFF
twilson@starhq.com

ERWIN -- Officials with Nuclear Fuel Services Inc. touted an "improved" system of performance enhancements during a meeting with officials of the U.S. Nuclear Regulatory Commission held here Thursday morning.

Officials from NRC's Region II office in Atlanta were at NFS to hear NFS officials discuss the company's performance enhancements created since it last met with the NRC in October. A new regulatory wrinkle NRC officials said they plan to add at NFS is a second on-site regulatory inspector at the NFS site since the company expanded its operation.

"Our processes deal with safety first," said Luis Reyes, regional administrator for Region II.

Presently, one on-site inspector has the run of the NFS facility to examine compliance with NRC regulations pertaining to nuclear materials facilities. While neither NRC nor NFS officials openly discussed the controversial Blended Low Enriched Uranium (BLEU) Project during the public meeting, the NRC acknowledged the company's growing operations were an impetus to add the second inspector.

During its presentation, company officials explained efforts to improve both safety and regulatory compliance at its facility with a greater emphasis on self-assessment procedures.

"I think we've improved," Marie Moore of NFS told NRC officials at the meeting held at the company's employee training center on Banner Hill Road.

An NRC response to a violation by NFS that occurred in January 2003 has moved to the "enforcement" stage according to NRC officials. The NRC's Office of Investigations for Region II initiated an investigation on April 11, 2003, to determine if an NFS decommissioning supervisor deliberately falsified records documenting the transfer of low-enriched uranium (LEU) solution.

In a letter from NRC's Division of Fuel Facilities Inspection dated Jan. 16, 2004, Region II's Office of Investigations substantiated that the decommissioning supervisor willfully authorized the transfer of LEU solution without conducting required verifications and reviews prior to and/or during the transfer.

Based on the evidence, documentation, and testimony during the investigation, NRC staff reported that they found insufficient evidence to substantiate that a decommissioning supervisor with NFS deliberately falsified records pertaining to the transfer of LEU. The decommissioning supervisor's documentation of the transfer resulted in the recording of inaccurate information pertaining to the transfer, according to an NRC investigation document. The incident occurred during decommissioning of a building at the Erwin site that has since been demolished.

NFS spokesman Tony Treadway said the company would not comment on specifics of the employee's actions, but he did say the matter was handled immediately after it occurred. "The matter was promptly and thoroughly reviewed by the NRC and NFS in January of last year," he said.

Reyes said the violation status has moved into consideration for escalated enforcement action and was turned over to the U.S. Department of Justice to determine whether additional actions would be pursued regarding the violation, as was NRC policy.

Trudy Wallack, a representative of the Friends of the Nolichchuky River Valley, questioned the difference between the terms "willful action" and "deliberate falsification".

"I would like to think that at this point the ongoing violation has to raise questions in the NRC like what qualifications and connections you have in place," Wallack said. "This is a chief concern, that we understand that no one is above error."
Wallack said she had trouble understanding what would motivate a decommissioning supervisor by making such an error. She and Modica are members of a consortium of environmental groups requesting a public hearing on the BLEU Project.
Wallack also asked if NRC were aware of information about an incident involving individuals of "middle Eastern" appearance that rented a hotel room near NFS and on Sept. 11 vacated the hotel room leaving all their belongings behind.
Reyes responded that NRC received a variety of information similar to that from the Department of Homeland Security and the FBI.
"Information such as that comes to our attention ... we can't go into details," he said. "We have had similar information, not only here but in other places.
"I can tell you we daily receive intelligence and information."
In total, the three related license amendment requests seeking to amend the Special Nuclear Materials license held by NFS have been submitted to the NRC for approval pertaining to the BLEU Project. The license amendments involve the construction of three new buildings -- the Uranyl Nitrate Building, the Oxide Conversion Building, and the Effluent Processing Building -- on a site referred to as the "BLEU Complex" at the company's site in Erwin.
The BLEU Project is a U.S. Department of Energy initiative to convert stockpiles of surplus weapons-grade uranium into a low-enriched uranium for use in nuclear reactors of the Tennessee Valley Authority. The project will bring more than 33 tons of weapons-grade uranium into Erwin for down blending.
NRC staff have already approved two of three license amendment requests to NFS Special Nuclear Materials license. The first license amendment application, approved by NRC in June 2003, grants NFS the ability to store LEU-bearing material in its Uranyl Nitrate Building. The second amendment enables NFS to process approximately half of the BLEU Project's 33 metric tons of surplus highly enriched uranium. A third license amendment, submitted by NFS in October 2003 seeks authority to construct and operate an Oxide Conversion Facility and related Effluent Processing Building, which is currently under review by the NRC.
These facilities will use a process developed by NFS, partner Framatome ANP. The facilities will convert the liquid uranyl nitrate solution into a uranium oxide powder, which will be further processed at Richland, Wash., into uranium fuel pellets for loading into fuel rods and assemblies for use in commercial nuclear reactors of the Tennessee Valley Authority.
Environmental groups including Friends of the Nolichucky River Valley, the State of Franklin Group of the Sierra Club, Oak Ridge Environmental Peace Alliance, and Tennessee Environmental Council along with a private citizen have filed petitions with the NRC seeking standing to have a public hearing regarding the BLEU Project. Fifteen Northeast Tennessee citizens represented by a Greeneville attorney have also filed separate petitions. Attorneys for NFS have asked the NRC to deny petitioners' requests for a hearing, stating that none of them had demonstrated "standing" or "injury in fact".

Staged incident?

Chase suspects held without bond

By Julie Ball, Staff Writer

May 10, 2004 10:54 p.m.

MARS HILL - Federal agents investigating two Israeli men charged with eluding Tennessee authorities found only furniture in searching a storage unit in Madison County Monday, according to the Unicoi County, Tenn., sheriff.

Sheriff Kent Harris said FBI agents searched the facility, which the men reportedly rented, but they found no evidence of anything suspicious.

The men, 22-year-old Shmuel Dahan and 19-year-old Almaliach Naor have told investigators they were on their way to West Virginia to deliver furniture.

They were arrested Saturday after a chase.

Both men were held without bond Monday afternoon as authorities sought to verify their passports.

Once the men were apprehended, officers found a fake Florida driver's license with Naor's picture on it in a duffel bag in the truck and a business card from a Florida flight instructor in one of the men's wallets.

The card read: "Learn how to fly" and "Fulfill your dream of flying" and listed the name and number of a Florida flight instructor.

The discovery led Harris and others to express concern about security at the Nuclear Fuel Services plant in Erwin. The plant makes nuclear fuel for submarines.

Harris spotted the Ryder truck the men were in about 3 p.m. Saturday on Old U.S. 23 near Flag Pond, Tenn. The truck was moving erratically and traveling at speeds of more than 60 mph, well above the maximum speed on the curvy road, according to Harris.

The sheriff said he turned on his blue light and siren, but the truck continued for more than two miles before stopping. Some people attending a cookout on Old U.S. 23 reported seeing someone in the truck toss out a brown, plastic container during the chase, Harris said.

"They (the people at the cookout) heard us coming and saw them throw that out," he said.

Dahan is charged with reckless driving, evading arrest, littering and false identification. Naor, a passenger in the truck, is charged with false identification.

Dahan's attorney, William B. Lawson of Erwin, said the men might have gotten lost and ended up on the mountain road.

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"They got lost, big time," Lawson said. "It doesn't seem like they have anything to hide."

Harris said early Monday afternoon he was waiting on the results of tests on the liquid substance in the brown container. The bottle contained a "gooey liquid" and some sort of pellets. The bottle appeared as if it had once held pesticides of some sort, but the label was missing. Field tests done by officers turned up no evidence of drugs. "We don't know exactly what's in it yet," Harris said.

The men maintain the container did not come from the truck, according to Harris. The Ryder truck contained old furniture.

The Florida flight instructor, Nissan Giat, said he met Naor at a moving company where the Israeli man works. Giat said he gave Naor one of his cards, but the man didn't express interest in flying lessons.

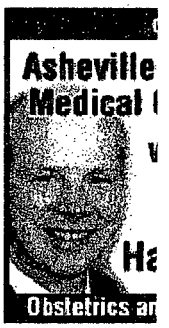
Giat said Naor was recently released from the Israeli army. "He's a good guy," Giat said. "He's not a terrorist."

Harris said the men rented the truck in Florida, where they were living and working.

The FBI confirmed both men are in the United States legally, and neither man has a criminal record, according to Harris. The sheriff was waiting for word Monday on the status of one of the men's passports.

Staff Writer Clarke Morrison contributed to this report.

Contact Ball at 232-5851 or JBall@CITIZEN-TIMES.com.



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United States General Accounting Office

GAO

Report to the Chairman, Environment, Energy, and Natural Resources Subcommittee, Committee on Government Operations, House of Representatives

May 1989

NUCLEAR REGULATION

NRC's Decommissioning Procedures and Criteria Need to Be Strengthened

GAO/RCED-89-119

GAO
United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-231254

May 26, 1989

The Honorable Mike Synar
Chairman, Environment, Energy,
and Natural Resources Subcommittee
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

On July 22, 1987, you asked us to determine the mechanisms that the Nuclear Regulatory Commission uses to ensure that fuel cycle facility operators and utilities with nuclear power plants appropriately provide for the decommissioning of these facilities. On the basis of subsequent discussions with your staff, we agreed to provide you with two reports—one on decommissioning cost estimates and another on the Commission's criteria and procedures for decommissioning fuel cycle facilities. In July 1988, we provided you with a report that discussed the adequacy of the Commission's decommissioning cost estimates and the methods that can be used to ensure that funds would be available. This report discusses other issues, such as the actions the Commission has taken or plans to take to ensure that fuel cycle facility licensees appropriately decommission their sites.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to appropriate congressional committees; the Chairman of the Commission; and the Director, Office of Management and Budget. We will also make copies available to others upon request.

This work was performed under the direction of Keith O. Fultz, Director, Energy Issues. Other major contributors are listed in appendix II.

Sincerely yours,

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

Today, 112 nuclear power plants, 22 facilities that support these plants, 54 reactors used in research, and approximately 23,000 organizations hold licenses from either the Nuclear Regulatory Commission (NRC) or various states to use radioactive material. In addition, government agencies, such as the Department of Energy, have a multiplicity of facilities that use and dispose of such material. Eventually, most of these facilities will be decommissioned, which involves removing the radioactive material and terminating the license.

The Chairman, Environment, Energy, and Natural Resources Subcommittee, House Committee on Government Operations, asked GAO to determine NRC's procedures to ensure that licensees appropriately decommission their facilities. On July 29, 1988, GAO provided the Chairman with a report that discussed the adequacy of NRC's decommissioning cost estimates. Since only limited decommissioning actions have occurred at nuclear power plants, this report primarily discusses the actions that NRC has taken to ensure that fuel cycle facility licensees appropriately decommission their sites.

Background

NRC regulates the private uses of nuclear material. NRC requires that at the end of their useful lives, owners of nuclear facilities have to remove the radioactive material from the site, including land, groundwater, buildings and contents, and equipment. This is called decontamination. To terminate their licenses, the owners must eventually decommission the site by reducing residual (any remaining) radioactivity to a level that allows the property to be used for unrestricted use (any purpose). Once decontaminated, NRC can also release part of a facility for unrestricted use without terminating the license.

NRC is not the only federal agency involved in the decommissioning process. Since 1970, the Environmental Protection Agency (EPA) has been responsible for developing residual radiation standards. EPA expects to complete this effort by 1992. In the interim, NRC uses guidelines developed in the early 1970s to ensure that residual contamination will not endanger public health and safety. (See ch. 1.)

Results in Brief

NRC needs to ensure that licensees appropriately decontaminate their facilities. Under current regulations, NRC cannot specifically require additional cleanup once it terminates a license. On the basis of a review of eight fuel cycle licensees, GAO found that NRC fully or partially released two sites for unrestricted use where contamination at 1 was up

to 4 times, and at the other, up to 320 times higher than NRC's guidelines allowed. The other six cases also indicated instances of poor regulatory oversight either because NRC did not require the licensees to fully document the decontamination activities conducted or the data that NRC did have were incomplete.

Also, for five licensees that buried waste, NRC does not know the types and amounts of radioactive waste that have been buried at four of the sites. Licensee records are either nonexistent or incomplete. Although NRC does not believe the buried waste has caused significant environmental damage, all five sites have groundwater contamination higher than federal drinking water standards allow. For at least four sites, some of the contamination appears to be caused by the buried waste and, at one site, the contamination was 400 times higher than the standards.

Further, no federal standards exist for acceptable levels of radiation that can remain after NRC terminates a license. As a result, licensees are using NRC guidance developed in the early 1970s to decommission their facilities.

Principal Findings

Licensees Do Not Adequately Decontaminate Their Facilities

In two of eight cases that GAO reviewed, NRC fully or partially released sites for unrestricted use where radioactive contamination was higher than its guidelines allowed. In one case, contamination in different parts of the facility ranged from about 3 to 320 times higher; in the other, contamination in some soil ranged from 2 to 4 times higher. For the other cases, GAO could not determine whether similar situations occurred because

- licensee information, such as surveys showing the cleanup activities conducted, was sometimes incomplete, ambiguous, or did not exist and
- NRC did not always have inspection or other information that confirmed or refuted the licensees' findings on the buildings, land, and equipment that had been decontaminated.

The concern over inadequate or incomplete NRC information is not new. Although GAO raised this concern to NRC in 1976 and 1982, problems still

exist today. Also, NRC's regulations do not specify how long either the agency or the licensees should retain information.

Further, where data existed, GAO found that some licensees had not initially decontaminated their facilities to meet NRC's guidelines. In one case, NRC had to go back and conduct at least four additional inspections prior to releasing two buildings from the license. The release was made only after the licensee conducted extensive decontamination activities that included removing interior walls, concrete floors, and part of a roof and building. Further, NRC requires licensees to decontaminate facilities below NRC's guidelines if cost-beneficial to do so. Eleven of 19 decommissioning plans did not show that the licensees would meet this requirement. (See ch. 2.)

Monitoring of Buried Waste Should Be Improved

For almost 25 years, NRC allowed licensees to bury radioactive waste onsite without prior NRC approval. NRC required the licensees to retain records on the amounts and substances buried rather than provide them to NRC. In five of the eight cases GAO reviewed, licensees buried waste onsite, but four licensees either did not keep disposal data or the data are incomplete. In one case, NRC terminated a license and 10 years later learned that radioactive material had been buried on the site. Also, NRC generally does not require licensees to monitor for groundwater or soil contamination from buried waste. All five licensees have found groundwater contaminated with radioactive substances. At four sites, some of the contamination appears to have resulted from the buried waste—the contamination at one site was 400 times higher than EPA's drinking water standards allow. At another site, the contamination was 730 times higher, but the source was not known. (See ch. 4.)

NRC Lacks Regulations to Require Cleanup After Terminating a License

If NRC terminates a license and subsequent events show that contamination is higher than NRC's guidelines allow, NRC staff believe they can require the former licensee to conduct additional cleanup activities to protect public health and safety. However, NRC's regulations do not address the actions that NRC can take. Since (1) NRC has found contamination in excess of its guidelines after terminating a license, (2) complete information does not exist for all licensed activities or buried waste, and (3) NRC's regulations do not contain a time requirement for document retention, NRC needs to ensure that an appropriate basis exists to support a license termination decision. According to NRC staff, they expect to propose regulations to implement their authority in this area but could not estimate when they would do so. (See ch. 4.)

Federal Residual Radiation Criteria Are Lacking

Since 1970, EPA has been responsible for developing residual radiation standards. EPA began to develop these standards in 1984 but, because of higher priority work, does not expect to finalize them until 1992. As a result, NRC uses guidelines it developed in the early 1970s to determine whether it can terminate a license. A professional group, the Health Physics Society Standards Committee, has also been developing residual radiation standards. For some radioactive material, the society proposed levels 3 to 50 times higher than NRC's guidelines and for other substances, 3 to 5 times lower. The society expects to complete the proposed standards by March 1991. (See ch. 3.)

Recommendations

To enhance NRC's regulatory oversight of decommissioning activities, GAO is making a number of recommendations. In part, GAO recommends that the Chairman, NRC,

- require licensees to specifically list in one document all land, buildings, and equipment involved with their licensed operations;
- ensure that the licensees decontaminate their facilities in accordance with NRC's guidelines before NRC fully or partially releases a site for unrestricted use;
- determine if NRC's residual radiation criteria should be revised on the basis of the standards proposed by the Health Physics Society Standards Committee;
- ensure that licensees appropriately monitor buried waste sites to determine the extent of environmental contamination; and
- ensure that NRC obtains and keeps decommissioning information for more than 10 years.

Agency Comments

GAO discussed the facts presented in this report with NRC. NRC generally agreed with the facts but offered some clarifications that were incorporated where appropriate. As requested, GAO did not ask NRC to review and comment officially on this report.

Contents

Tables

Abbreviations

ANSI	American National Standards Institute
EPA	Environmental Protection Agency
CE	Combustion Engineering, Inc.
CFR	Code of Federal Regulations
DOE	Department of Energy
GAO	General Accounting Office
GE	General Electric Company
GUNC	Gulf United Nuclear Corporation
NFS	Nuclear Fuel Services, Inc.
NRC	Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
TI	Texas Instruments, Inc.
UNC	United Nuclear Corporation

Introduction

The Atomic Energy Act of 1954, as amended, allowed and encouraged the development of peaceful uses of nuclear materials, including commercial nuclear power plants. Along with the development of nuclear power, a commercial infrastructure, including fuel cycle facilities, was developed to support the plants. Fuel cycle facilities include plants that convert uranium ore to a gas suitable for enrichment, fabricate the enriched uranium into fuel elements, and reprocess the spent or used reactor fuel to recover unused materials for refabrication into new fuel elements. As of April 1989, the Nuclear Regulatory Commission (NRC), the agency responsible for regulating private uses of nuclear materials, had licenses with 112 nuclear power plants; 22 facilities that support the industry; about 54 reactors used in research; and, along with states authorized by NRC to perform certain regulatory functions, approximately 23,000 organizations for industrial, medical, and educational purposes. Each of these activities will eventually have to be decommissioned; the manner and extent depend on the radiation hazards present.

Decommissioning Nuclear Facilities

At the end of their useful lives, the owners and/or operators of nuclear facilities, including the site, buildings and contents, and equipment, have to decontaminate the facilities by removing the radioactive material they contain. To terminate their NRC license, the owners must decommission the facilities by removing them safely from service and reducing the residual (remaining) radioactivity to a level that allows the property to be used for unrestricted use (any purpose). Once decontaminated, NRC can release part of a facility for unrestricted use without terminating the license.

Further, owners of commercial nuclear power plants do not have to take all decontamination actions immediately. NRC's regulations allow the owners to partially decontaminate the facilities and protect access to them. However, most of these facilities will probably be decommissioned within 60 years of the end of their useful lives. During that time, radioactive material with a short half-life[1] will decay to levels that will reduce worker exposures and the volume of waste generated.

Because of their size and the large inventory of radioactive materials, commercial nuclear power plants will pose unique decommissioning problems. However, no utility has decommissioned a large plant (about 1,000 megawatts), and NRC does not expect a utility to do so until after the year 2000. Because no facility exists to permanently dispose of the

[1]Time required for radioactive material to decay or decrease by 50 percent.

high-level waste produced by commercial nuclear power plants, utilities plan to partially decontaminate them and put them into "safe storage" until a high-level waste repository is available. As of January 1989, seven small nuclear plants had started decommissioning.[2] NRC has approved decommissioning plans for four of the plants. In addition, about 60 demonstration, military, and research reactors have been or are being decommissioned, including the Department of Energy's (DOE) 22-megawatt Elk River reactor. DOE is also decommissioning its 72-megawatt reactor at Shippingport, Pennsylvania, and expects to complete these activities in 1990. Further, 14 of the 22 currently licensed fuel cycle facilities have completed, or are in the process of, decontaminating all or a portion of their sites. Table 1.1 shows these facilities and the status of their decommissioning activities.

Table 1.1: Status of Fuel Cycle Facility Decommissioning Efforts as of October 31, 1988

Type/licensee/location	Type of material primarily processed	Status
Uranium conversion plants:		
Allied-Signal, Metropolis, Ill.	Conversion of uranium oxides to uranium hexafluoride	Operating.
Sequoyah Fuels, Gore, Okla.	Conversion of uranium oxides to uranium hexafluoride	Operating.
Uranium fuel fabrication plants:		
Babcock and Wilcox, Lynchburg, Va.	High- and low-enriched uranium	Both a high- and a low-enriched plant are operating.
Babcock and Wilcox, Apollo, Pa.	High- and low-enriched uranium	Some high- and low-enriched areas have been decontaminated. Decontamination of site ongoing.
Combustion Engineering, Windsor, Conn.	Low-enriched uranium	Operating.
Combustion Engineering, Hematite, Mo.	High- and low-enriched uranium	High-enriched uranium facility decontaminated. Low-enriched fuel operation ongoing.
Advanced Nuclear Fuels Corp., Richland, Wash.	Low-enriched uranium/plutonium	Plutonium building essentially decommissioned. Low-enriched fuel operations ongoing.
GA Technologies, San Diego, Calif.	High- and low-enriched uranium	Facility in standby status.
General Electric, Wilmington, N.C.	Low-enriched uranium	Operating.
Cimarron Corp. (Kerr-McGee), Crescent, Okla.	Low-enriched uranium	Facility partially decommissioned. Company plans to decommission entire site within a few years.

(continued)

[2]Humboldt Bay 3, California; Fermi 1, Michigan; Indian Point 1, New York; Vallecitos Boiling Water Reactor, California; Dresden 1, Illinois; Peach Bottom 1, Pennsylvania; and LaCrosse, Wisconsin.

Type/licensee/location	Type of material primarily processed	Status
Nuclear Fuel Services, Erwin, Tenn.	High- and low-enriched uranium/plutonium	Plutonium facility and some uranium buildings being decommissioned. Other processes ongoing.
Texas Instruments, Attleboro, Mass.	High-enriched uranium	Facility being decommissioned. Company plans to decommission entire site.
United Nuclear, Montville, Conn.	High-enriched uranium	Operating.
United Nuclear, Wood River Junction, R.I.	High-enriched uranium	Facilities being decommissioned. Company plans to decommission entire site.
Westinghouse, Columbia, S.C.	Low-enriched uranium	Operating.
Plutonium fabrication plants:		
Babcock and Wilcox, Lynchburg, Va.	Plutonium	Plutonium facilities decontaminated. Facility being used for reactor service instrumentation.
Babcock and Wilcox, Parks Township, Pa.	Plutonium	Plutonium facility being decontaminated. Other processes ongoing.
Battelle Columbus Division, Columbus, Ohio	Plutonium	Plutonium facility decommissioned. Company plans to decommission entire site.
Energy Systems Group (Rockwell), Canoga Park, Calif.	Plutonium	Plutonium facility being decontaminated. Other activities ongoing.
General Electric, Vallecitos, Calif.	Plutonium	Plutonium facility decommissioned. Other processes ongoing.
Cimarron Corp. (Kerr-McGee), Crescent, Okla.	Plutonium	Plutonium facility being decommissioned. Company plans to decommission entire site.
Westinghouse, Cheswick, Pa.	Plutonium	Plutonium facility decontaminated. Other activities ongoing.

Source: NRC, Fuel Cycle Safety Branch, Office of Nuclear Material Safety and Safeguards.

NRC's Organization for Regulating Nuclear Facilities

Under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended, NRC regulates the possession and use of radioactive material and ensures that the public is protected from the hazards of the material. NRC regulations for commercial power plants and fuel cycle facilities are primarily set forth in 10 CFR Parts 20, 40, 50, and 70. To carry out its responsibilities, NRC sets standards and makes rules, conducts or contracts for technical reviews and studies, issues licenses, and conducts inspections. Within NRC, the Office of Nuclear Reactor Regulation regulates utilities with nuclear power plants; the Office of Nuclear Material Safety and Safeguards regulates fuel cycle operators.

Until recently, NRC did not have specific regulations for decommissioning nuclear facilities. On July 27, 1988, new regulations took effect that set out technical and financial criteria for decommissioning licensed nuclear facilities. The regulations addressed decommissioning planning,

timing, funding methods, and environmental review requirements. The regulations do not include the removal and disposal of spent (used) fuel or nonradioactive structures and materials as decommissioning activities. In a July 1988 report, we assessed the adequacy of NRC's decommissioning cost estimates and the methods that utilities and fuel cycle operators can use to set aside funds for these activities.[3]

Other Federal Agencies Involved in Decommissioning

NRC is not the only federal agency involved in the decommissioning process. For example, since 1970 the Environmental Protection Agency (EPA) has been responsible for developing standards for acceptable levels of residual radiation that can remain after a licensee completes decommissioning activities. According to EPA officials, the criteria will address residual contamination (1) in soil, (2) on interior building surfaces and equipment, and (3) for materials that can be reused, such as piping, chemicals, or mixing containers. In this regard, EPA issued an advanced notice of proposed rulemaking in the June 18, 1986, Federal Register. EPA radiation program officials do not expect to have a final rule until 1992. NRC will then incorporate the rule into its regulations.

In addition to EPA, the Occupational Safety and Health Administration sets standards for worker protection, such as the use of protective clothing. Further, the Department of Transportation regulates the safe transportation of waste, equipment, and other materials from the plants to disposal sites.

NRC's Decommissioning Criteria

Until EPA finalizes its residual radiation standards, NRC will continue to use guidelines developed in the early 1970s to determine whether a portion or all of a facility should be released for unrestricted use. The guides describe the methods and procedures that NRC considers acceptable for licensees who want to terminate their licenses. For many radioactive substances, the guides specify acceptable levels of residual contamination that can remain after NRC terminates the license. Further, the guides state that a licensee should make a reasonable effort to eliminate residual radiation and survey the facility to determine that the levels of radioactivity are within NRC's limits.

The surveys should (1) identify the specific buildings and/or properties that will be released, (2) describe the scope and procedures followed to

[3]Nuclear Regulation: NRC's Decommissioning Cost Estimates Appear Low (GAO/RCED-88-184, July 29, 1988).

clean up the facilities, and (3) list the amounts of radioactive material that remain. Upon receiving the survey results, NRC reviews them and, in most cases, has used a contractor, primarily Oak Ridge Associated Universities (ORAU), to conduct a confirmatory survey to verify the survey results. In all cases, according to NRC staff, NRC evaluates both the licensee's and ORAU's results and draws appropriate conclusions.

To determine acceptable levels of contamination on building surfaces, NRC uses Regulatory Guide 1.86 (June 1974) for nuclear reactors and an unnumbered guide initially developed in April 1970 and revised in May 1973, November 1976, and August 1987 for fuel cycle facilities and other licensees (Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Materials[4]). In addition, since 1981 NRC has used a branch technical position to determine acceptable levels of uranium and thorium contamination that can remain in the soil on the sites. Prior to 1981, NRC set soil contamination limits on a case-by-case basis. NRC uses the technical position for fuel cycle plants; it specifies maximum concentrations of uranium and thorium that can remain after NRC terminates the license. However, some fuel cycle operators conducted activities using plutonium; the technical position does not address this or other types of radioactive contamination.

Under the technical position, licensees have four options concerning the clean up of contaminated soil. The options address different concentrations of material that can remain in the soil. Option 1, for instance, allows NRC to release a site for unrestricted use if soil contamination is between 10 and 35 picocuries[5] per gram (depending on the type of material). Option 4, on the other hand, allows for higher concentrations (200 to 3,000 picocuries per gram, depending on the type of material) that can remain. Under option 4, however, the title documents must state that the land (1) contains buried radioactive material and (2) cannot be used for residential or agricultural purposes.

NRC also uses a 1983 Standard Review Plan to terminate fuel cycle facility licenses. The Standard Review Plan provides guidance to staff responsible for reviewing applications for terminating licenses and

[4]According to NRC staff, they refer to these guidelines as Annex C in all fuel cycle facility licenses. For purposes of this report, when discussing the unnumbered guidelines, we will refer to them as Annex C.

[5]A curie is a measure of the rate of radioactive decay. A picocurie is equivalent to one-trillionth of a curie.

releasing facilities for unrestricted use. The plan sets forth areas of responsibility among NRC organizations to ensure that a facility licensed to possess or use radioactive material has been adequately decontaminated to levels consistent with NRC's unrestricted use guidelines.

Objectives, Scope, and Methodology

On July 22, 1987, the Chairman, Environment, Energy, and Natural Resources Subcommittee, House Committee on Government Operations, asked us to determine the mechanisms NRC uses to ensure that utilities with nuclear power plants and operators of fuel cycle facilities appropriately provide for the eventual decommissioning of their facilities. In July 1988, we reported on the adequacy of NRC's decommissioning cost estimates and the methods utilities and/or operators can use to ensure that funds would be available. This report discusses other decommissioning issues, including the actions licensees take to comply with NRC's residual radiation guides and NRC's assessment of facilities prior to terminating the license.

To obtain the information needed, we reviewed the Atomic Energy Act, the Energy Reorganization Act, and NRC's regulations, guidelines, and inspection reports. We also reviewed licensee environmental impact statements, environmental assessment reports, and radiological survey reports prepared by the licensees or ORAU as well as NRC's July 1988 decommissioning regulations and over 50 reports or articles that addressed decommissioning. Some of the studies that we reviewed included a 1983 Nuclear Management and Resources Council report An Overview of Decommissioning Nuclear Power Plants, NRC's January 1981 draft and 1988 final "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities," and an April 1985 Public Citizen Environmental Action report, Dismantling the Myths about Nuclear Decommissioning. In addition, we attended a 1987 international decommissioning symposium in Pittsburgh, Pennsylvania. We also used information in two of our reports and evaluated the actions that NRC took in response to the recommendations made.[6]

Further, we met with NRC staff in the Offices of Nuclear Material Safety and Safeguards, Nuclear Regulatory Research, Nuclear Reactor Regulation, and General Counsel; a DOE official in the Office of Remedial Action

[6]See Cleaning Up the Remains of Nuclear Facilities—A Multibillion Dollar Problem (EMD-77-46, June 16, 1977) and Cleaning Up Nuclear Facilities—An Aggressive and Unified Federal Program Is Needed (EMD-82-40, May 25, 1982).

and Waste Technology; the former Director, Shippingport decommissioning project; and officials from Westinghouse Electric Corporation, Cheswick, Pennsylvania; Kerr-McGee Corporation, Crescent, Oklahoma; and Nuclear Fuels Services Corporation, Erwin, Tennessee. We also discussed decommissioning issues with a wide spectrum of knowledgeable experts from the Edison Electric Institute, National Association of Regulatory Utility Commissioners, TLG Engineering, Inc., Worldwatch Institute, Nuclear Management and Resources Council, and ORAU.

To determine the decommissioning methods that fuel cycle facility operators use, we obtained a list of 22 licenses that NRC had with 13 companies as of June 1987. We reviewed 19 decommissioning plans (3 licensees did not submit these plans) and selected 8 licensees for detailed review (app. I summarizes the 8 cases). We selected two of the eight licensees because NRC had terminated at least one license at the site or released all the land and/or buildings for unrestricted use, five because they were in the process of conducting decommissioning activities and had some part of their facility released by NRC for unrestricted use, and one that recently started to decommission its facilities. For all eight cases, we reviewed the actions that the licensees took to comply with NRC's requirements and, where applicable, NRC's actions prior to terminating a license.

In addition, we visited three licensees—Cimarron Corporation, Westinghouse Corporation, and Nuclear Fuel Services–to tour the facilities, observe the operations conducted and radioactive waste disposal methods used, and discuss their ongoing decommissioning activities. We also met with ORAU officials to determine the activities they perform for NRC, the results of their analyses, and their views on the adequacy of licensees' decontamination activities. We also reviewed NRC's Standard Review Plan for terminating fuel cycle facility licenses and inspection reports of licensee decontamination efforts.

Because no utility has decommissioned a commercial nuclear power plant, we did not review in detail NRC's process for terminating these licenses. However, we did review decommissioning plans submitted by five utilities to determine the methods they plan to use. The plants included Humboldt Bay 3, California; Indian Point 1, New York; Peach Bottom 1, Pennsylvania; Vallecitos Boiling Water Reactor, California; and Fermi 1, Michigan. We selected these five because decommissioning plans were available.

To evaluate the reasonableness of the criteria NRC uses to release facilities and land for unrestricted use, we compared NRC's Regulatory Guide 1.86, Annex C of fuel cycle facility licenses, and NRC's branch technical position with criteria being developed by the American National Standards Institute (ANSI). We also spoke with the Chairman, Health Physics Society Standards Committee, the group that developed the criteria under consideration by ANSI, and EPA radiation program officials responsible for developing the residual radiation regulations.

Further, we obtained NRC's regulations (10 CFR Parts 20.201, 20.302, 20.304, and 20.401) concerning the burial of radioactive waste by fuel cycle operators and met with NRC staff in the Offices of Nuclear Material Safety and Safeguards and General Counsel to discuss those requirements. We also obtained information on the types and amount of waste that licensees could bury on their property, the recordkeeping requirements for such disposal, and NRC's requirements and licensees' plans to clean up the contamination and/or monitor the waste to ensure that it does not migrate (move). We also spoke with the coauthor of a 1980 report, Identification of Technical Problems Encountered in the Shallow Land Burial of Low-Level Radioactive Wastes (ORNL/SUB-80/13619/1), as well as ORAU officials regarding the technical problems that have been encountered with buried low-level radioactive waste, the likelihood that the waste could migrate and contaminate the environment, and the results of the radiological surveys they have conducted at buried waste sites. We also reviewed an Electric Power Research Institute report on migration of plutonium waste. On the basis of all the data gathered, we conducted a limited assessment of NRC's internal controls related to the procedures used to terminate fuel cycle facility licenses.

We discussed the facts presented in this report with NRC staff in the Offices of Nuclear Material Safety and Safeguards, Nuclear Reactor Regulation, Nuclear Regulatory Research, and General Counsel. Generally, they agreed with the facts but offered some clarifications that were incorporated where appropriate. As requested, we did not ask NRC to review and comment officially on this report. Our work was conducted between August 1987 and October 1988 in accordance with generally accepted government auditing standards.

NRC Does Not Ensure the Cleanup of All Radioactive Material

In two of the eight cases that we reviewed, NRC fully or partially released sites for unrestricted use that had radioactive contamination higher than NRC's guidelines. In one case, the contamination ranged from about 3 to 320 times higher; in the other, from 1.5 to 4.4 times higher. We could not determine if additional contamination existed at these sites or if similar problems occurred in the remaining six cases because NRC either did not have information, such as the licensees' radiological surveys, or the information it did have was incomplete.

Further, because the long-term effects of exposure to low-levels of radiation are not well known, a need exists for licensees to make a reasonable effort to eliminate residual contamination. However, in the eight cases we reviewed, the licensees generally did not do so. NRC inspection reports and ORAU confirmatory surveys show numerous instances where NRC required licensees to conduct additional decontamination activities at their facilities. Because no large nuclear power plant has been decommissioned, we could not assess utilities' practices in this area. However, our review of decommissioning plans for five plants showed that the utilities did not discuss the methods to be used to eliminate residual contamination. Rather, they primarily concentrated on the safe on-site storage of the plant until the time the utility would start to decommission it.

NRC's Actions Resulted in the Government's Incurring Cleanup Costs

In July 1975, NRC terminated a license held by Gulf United Nuclear Corporation (GUNC) in New York.[1] Subsequently, radiation in excess of NRC's guidelines was found. As a result, the purchaser of the site—the National Park Service—has spent about $80,500 to clean up the site and may have to incur total costs of at least $388,000 before the site meets NRC's guidelines.

In 1958, GUNC received a license to fabricate and/or test uranium oxide, thorium, and plutonium fuels. The facility, located near Pawling, New York, included about 1,170 acres of land, about 9 buildings, and a 55-acre lake (Nuclear Lake). GUNC stopped all operations in 1972 and contracted with Atcor Incorporated to decontaminate and survey the site. Atcor, however, did not take adequate soil or any lake sediment samples as part of the survey. After receiving the survey results, NRC inspected the site and performed a confirmatory survey to verify that it could release the site for unrestricted use. NRC took building and soil samples

[1]From 1958 until 1975, various companies had been involved with the license—Nuclear Development Corporation of America, United Nuclear Corporation, GUNC, and the General Atomic Company. For this report, we refer to the various licensees as GUNC since NRC documents continue to refer to this company as the prior licensee.

and found several areas that required further cleanup by the licensee. After GUNC notified NRC that the areas had been decontaminated, NRC terminated the license on July 14, 1975.

Subsequently, GUNC sold the site to Harpoon, Inc., which in June 1979 sold the property to the U.S. Department of the Interior's National Park Service for relocating part of the Appalachian National Scenic Trail. After the National Park Service acquired the property, it contracted with Nuclear Energy Services to survey portions of the site. Nuclear Energy Services' July 1984 survey report showed residual contamination in a small area of the waste disposal building that was 35 times higher than NRC's guidelines.

After making various studies and reviews, a local group, the Nuclear Lake Management Committee, raised concerns regarding residual contamination in building drains, septic tank and drain systems, and various buildings. The committee was also concerned that radioactive or hazardous wastes may have been disposed of in the lake. To resolve some of these concerns, the National Park Service contracted with ORAU to survey the site. ORAU found that the contamination in building drains, septic systems, and the lake were within NRC's guidelines. However, ORAU found surface contamination in two buildings and soil contamination outside one building that ranged from about 3 to 320 times higher than NRC's guidelines and over 50 unidentified objects on the lake bottom that needed to be investigated further. Table 2.1 shows NRC's release limits and the contamination levels found by ORAU.

Table 2.1: Comparison of NRC's Release Limits With Contamination Levels Found by ORAU

NRC guidelines[a]	Facilities or areas exceeding guidelines	Remarks
Surface contamination:		
Plutonium-239, 2,500/dpm/ 100 cm^2	Plutonium Building—radiation levels were almost four times higher	Contaminated floors in five rooms
Cesium-137, 1.0 mrad/hr.	Plutonium Building—radiation levels were as much as 320 times higher	Floor area in two rooms
Cesium-137, 1.0 mrad/hr.	Multiple Failure Building—radiation levels were almost three times higher	Two areas in one room
Soil concentration:		
Plutonium-239, 2 dpm/g	Areas around Plutonium and Waste Disposal Buildings—radiation level at 1 area was 100 times higher	Twelve contaminated areas around the buildings.

[a]NRC's guidelines in effect in 1975.

As of December 1, 1988, no certainty existed that all the radioactive contamination had been removed from the site. According to ORAU's project manager responsible for surveying the site, ORAU took only a few measurements in each building, primarily at locations where previous surveys had shown elevated contamination levels. The official believes that additional contamination would have been found if ORAU had conducted a more in-depth survey. In its final report, ORAU identified several areas where cleanup is needed or further assessments are necessary to fully characterize conditions. According to the official, the National Park Service did not ask ORAU to do a more extensive survey.

ORAU's project manager said that he believed NRC should not have released the site for unrestricted use because subsequent surveys showed that much higher radioactivity existed than NRC allowed at the time the site was released. For example, although no formal criterion existed for soil contamination, the licensee agreed to limit plutonium contamination to two disintegrations[2] per minute per gram. ORAU found a few areas that were up to 100 times higher than the limit. The project manager said that information provided by the licensee's contractor (Atcor Inc.) was insufficient because no lake sediment samples had been taken, even though some radioactive process waste appeared to have been released into the lake. Over time, however, contamination can build

[2]A measure of the intensity of radiation given off by radioactive material.

up and concentrate in the sediments. Although ORAU readings showed that the sediments were generally within NRC's limits, the project manager said that because of the apparent release of radioactive material into the lake, it would have been appropriate for NRC to determine whether contamination existed in the sediment.

Because complete information on the extent of the contamination at the site is not available, neither NRC, the National Park Service, nor ORAU could estimate the cost to clean up the site and lake to meet today's standards. To date, the National Park Service has spent about $80,500 to clean up the site and an official estimates that the total cost could be $388,000 or higher if ORAU finds additional contamination. The official also said that ORAU has recommended that it conduct a thorough site survey at a cost of about $108,000. As a result, the National Park Service is now considering a number of cleanup options for the site.

Some Contaminated Soil Exceeded NRC's Guidelines

Since 1980, NRC has been releasing land at the Nuclear Fuel Services (NFS) site in Tennessee for unrestricted use. NRC released the land, although contamination in some soil ranged from 1.5 to 4.4 higher than its guidelines allowed.

NFS received a license in 1958 to convert uranium hexafluoride gas to fuel for reactors, fabricate reactor fuel using thorium and plutonium, and recover both uranium and thorium from the processes conducted. The site covers 58 acres in eastern Tennessee and includes over 20 buildings as well as 3 ponds and 3 burial sites, which had been used to dispose of liquid and solid low-level radioactive waste, respectively. Between 1958 and 1968, NFS discharged liquid uranium and thorium waste to holding ponds which, in turn, discharged into a small stream (Banner Spring) that flows through the site. The stream also flowed through property owned by the Clinchfield Railroad. In 1968, NFS diverted the flow of Banner Spring.

In 1980, NFS asked NRC to release some of the land for unrestricted use. The land included the stream bed of the Banner Spring before NFS diverted its flow. As required, NFS conducted a radiological survey of the land and concluded that the contaminated soil was within NRC's guidelines. However, NRC's confirmatory survey found contamination that was between 1.5 and 4.4 times higher than allowable levels. Despite this finding, in a September 1980 letter, NRC released about 36,250 square feet of land adjacent to Clinchfield's property for unrestricted use. NRC documents show that a number of factors caused NRC to release the land

even though the contamination exceeded its release guidelines. For example, NRC concluded that (1) its guidelines merely set a "target" value rather than an absolute value that must be achieved, (2) the contaminated soil would be covered with approximately 7 feet of dirt, essentially eliminating the exposure pathway, and (3) the average concentration of the contaminated soil was within NRC's guidelines.

Further, in 1984 NFS asked NRC to release additional land from its license. Again the land was on the Clinchfield property and the site of the old Banner Spring stream bed. NFS surveyed the property; NRC made a confirmatory survey. On July 24, 1987, NRC released the land even though some soil contamination was almost 3 times higher than NRC's guidelines. NRC did not require the cleanup of all the contaminated soil because the staff concluded that the contamination level was low and would not adversely affect public health and safety because the land was only used by the railroad.

Information Lacking to Determine if Other Problems Occurred

We could not determine whether the Pawling and NFS cases demonstrated isolated instances of poor regulatory oversight by NRC or systemic problems with NRC's process to ensure that licensees appropriately decontaminate and decommission their sites. In the other cases that we reviewed, NRC has released buildings, land, and parts of buildings. However, NRC either did not have information, such as licensees' radiological surveys or NRC's confirmatory surveys, or the information it had was incomplete. The following four cases illustrate various deficiencies in NRC's practices to ensure that licensees appropriately decontaminate and/or decommission their facilities.

Westinghouse Electric Corporation, Cheswick, Pennsylvania

In 1959 Westinghouse received a license to make fuel for commercial nuclear power plants; NRC terminated the license on August 20, 1974. According to NRC staff, Westinghouse conducted fuel fabrication activities in three buildings (5B, 5D, and a laboratory in 5A). However, when NRC terminated the license, it neither specified the buildings nor land that was released. As a result, we had to rely on inspection reports, letters, or memoranda to identify the buildings that NRC may have released for unrestricted use when it terminated the license. For example, NRC referred to a June 1974 inspection report of a uranium fabrication facility where licensed activities were conducted. The inspection report does not state whether this facility was building 5B, 5D, some other building, or a combination of buildings. In addition, neither NRC nor Westinghouse

could provide us with the company's radiological survey for two buildings (5B and 5D) or the soil around them. Without this information, we could not determine whether Westinghouse complied with NRC's procedures or a basis existed for NRC to terminate the license.

General Electric Company, San Jose, California

General Electric (GE) received a license in 1967 to make fuel for nuclear power plants. In 1982 the company notified NRC that it wanted to terminate the license; NRC did so on August 20, 1985. GE's site contained a number of buildings, but according to NRC documents, most of the radioactive contamination appeared to have occurred in buildings H and J, which were used to convert uranium hexafluoride gas to a form suitable for fuel and assemble the fuel following the conversion process.

NRC terminated the license in August 1985, and at the same time, transferred responsibility for the license to the state of California. Before the state accepted this responsibility, NRC required GE to decontaminate buildings H and J and submit the results to NRC. According to NRC documents, GE surveyed buildings H and J; NRC conducted a confirmatory survey and concluded that the contamination in the two buildings was below NRC's guidelines. However, NRC's files did not contain GE's survey reports for the two buildings. At our request, NRC searched its files and found some GE draft surveys and a brief NRC summary of GE's final survey for building J. According to NRC's guidelines, the company should have conducted, and NRC should have retained, the radiation survey reports.

In addition to the San Jose location, GE's license covered activities performed at other locations. NRC's files did not show if GE had surveyed those locations or provided any type of confirmation that, if they were contaminated, they did not exceed NRC's guidelines for release.

United Nuclear Corporation, New Haven and Montville, Connecticut

On February 28, 1969, United Nuclear Corporation (UNC) received a license to fabricate fuel for the naval reactor program at two sites: New Haven and Montville, Connecticut. The New Haven site included about 12 buildings; the Montville site encompassed about 235 acres on the Thames River about 50 miles northeast of New Haven. UNC stopped operating the New Haven facility in 1975 but continues to operate the Montville site.

According to available documentation, UNC decontaminated many buildings and some land at New Haven in 1975 and 1976. However, NRC's files

did not contain UNC's radiological surveys for three buildings (5E, 6E, and 18H). According to a UNC official, the company did not survey buildings 5E and 6E because they were used only for administrative and engineering activities and, monitoring conducted while the facility operated, showed that the contamination was well within NRC's guidelines. NRC staff confirmed this information. However, NRC's files did not contain any information concerning a radiological survey for building 18H. According to NRC staff, a company official told them that the building was used for administrative purposes; NRC did not verify this information. NRC did acknowledge that UNC should have surveyed the building to determine if contamination existed, and NRC should have some documentation supporting the findings.

In addition, UNC's survey report for nine buildings located at New Haven stated that the company had taken soil samples at five locations and water samples from on-site storm basins. However, the report did not provide the results of the samples but stated that the information would be provided to NRC later. NRC files did not have this information. According to NRC staff, they do not know if UNC took the samples or sent the results to NRC.

Gulf United Nuclear Corporation, Pawling, New York

In 1975, when NRC terminated its license with GUNC at Pawling, New York, it also released three buildings (19H, 41H, and 50H) located at New Haven, Connecticut, and facilities located in Eastview and White Plains, New York, that had been transferred to GUNC around 1974. For these locations, NRC had only one radiological survey that addressed two buildings (19H and 50H); building 41H and the Eastview and White Plains locations were not addressed. Further, the survey may not be complete because it only discussed parts of buildings 19H and 50H, not the entire buildings. NRC staff could not tell us if the licensee had surveyed the entire buildings and only reported on those areas that were contaminated or if the licensee merely surveyed portions of the buildings. In addition, NRC staff pointed out that regulatory responsibility for the Eastview site was transferred to the state of New York. An NRC staff member does remember that the licensee surveyed the Eastview site but could not recall the results or whether the state or NRC did a confirmatory survey before the license was terminated. For White Plains, NRC staff do not know when the facility was released, whether the licensee performed a survey, or whether NRC verified the results.

However, the concern over inadequate or incomplete NRC information is not new. For example, in 1976 we took a random sample of NRC files and

found that documentation was lacking or inadequate to demonstrate that all terminated licenses had been accompanied by adequate decontamination and/or radiological surveys. In a September 1976 letter, we provided this information to NRC. Subsequently, NRC asked DOE's Oak Ridge National Laboratory to review the matter. In its June 1980 report, Oak Ridge also found that some licensees' files (including fuel cycle facilities) contained no site decommissioning or final survey documents. As a result of the laboratory's findings, NRC reexamined its terminated license files and found that 54 out of 668 were questionable because of inadequate or incomplete information.

Further, in 1982 we again found that NRC did not have adequate information, records, or files on which to base its license termination decisions.[3] This occurred because NRC could not locate all files and, in many cases, the files did not contain information on the cleanup activities required or the licensees' actions to decontaminate the facilities. For example, we found that NRC did not have (1) radiological surveys and other pertinent data, (2) information showing the methods that licensees used to dispose of radioactive material, and (3) appropriate site identification data. Our current review of NRC records for eight fuel cycle licensees showed similar weaknesses.

According to NRC staff, they are required to keep decommissioning records for about 10 years after terminating a license. NRC does not have a similar requirement for former licensees. In some cases, such as burials of licensed materials or disposal of waste to sanitary sewage systems, NRC requires licensees to retain records until NRC authorizes their disposition. In other cases, however—such as licensee radiological surveys, NRC's and ORAU's confirmatory surveys, and information on buildings, land, and equipment that were contaminated during the license—NRC only requires the licensee to keep records until the license is terminated.

Some Licensees Do Not Effectively Decontaminate Facilities

In addition to NRC's terminating some licenses without complete information, NRC confirmatory surveys and ORAU survey reports showed instances where licensees did not effectively decontaminate their facilities to meet NRC's guidelines. For example, in January 1983, Texas Instruments (TI) submitted a radiological survey to NRC for its Attleboro, Massachusetts, facility. TI's survey showed that the quantities of radioactive materials buried at the site were sufficiently low to justify their

[3]See EMD-82-40, May 25, 1982.

being left in place. However, an April 1984 ORAU survey found some areas of surface and subsurface contamination that were between 7 and 68 times higher, respectively, than NRC's guidelines. The contamination was located primarily within the boundaries of a suspected burial site and in a few locations around one building. In addition, a sample from a groundwater monitoring well showed radioactive contamination that was six times higher than EPA's drinking water standards.[4] According to NRC officials, the buried materials have been stabilized and the matter is still being reviewed by NRC.

Further, prior to terminating its license, GE surveyed its San Jose, California, site and concluded that the contamination for buildings H and J was below NRC's limits; NRC's confirmatory surveys proved otherwise. Between August 1982 and September 1984, NRC surveyed the buildings at least five times. During four of the surveys, NRC identified locations where contamination exceeded its guidelines and required GE to conduct further decontamination activities. For example, in the J building, GE had to remove interior walls, concrete floors, drainage lines, and portions of the roof to reduce contamination. In addition, in the H building, NRC found some contamination that was eight times higher than its guidelines allowed. GE reduced the contamination by removing part of the building. Further, NRC collected 13 soil samples and found that 4 contained contamination ranging from 1 to 77 times higher than its guidelines. To bring the concentrations within NRC's guidelines, GE had to do further decontamination work. NRC's documents were silent, however, on the methods GE used to carry out its efforts.

Also, NRC directs licensees to decontaminate their facilities to levels lower than NRC's release guidelines if it is cost/beneficial to do so. If NRC later institutes more restrictive release criteria, the facilities may already meet them, and additional decontamination work would not be needed. Our review of 19 fuel cycle facility decommissioning plans showed, however, that 11 did not discuss the actions that licensees would take to reduce residual contamination below NRC's guidelines. The remaining eight plans stated that the licensees would make a reasonable effort, and three of the eight provided details on the actions to be taken. Further, our review of decommissioning plans for five nuclear power plants showed that the utilities expect to meet NRC's guidelines but do not plan to reduce contamination below the limits established.

[4]EPA's drinking water standards establish a limit of 15 and 50 picocuries per liter for gross alpha and gross beta, respectively. NRC's Standard Review Plan suggests that NRC staff use EPA's drinking water standards to determine whether radiation levels in groundwater are acceptable for unrestricted use.

Federal Criteria Needed for Acceptable Levels of Residual Radiation

Although residual radiation standards would provide a sound decision-making basis for the types and extent of decommissioning activities required, no federal regulations exist concerning acceptable levels of contamination that can remain after NRC terminates a license. As a result, NRC uses guidelines developed in the early 1970s to determine that it can terminate a license and/or release a site for unrestricted use. However, a professional group, the Health Physics Society Standards Committee, has been developing residual radiation standards that, for some substances, are 3 to 50 times higher and, for other substances, 3 to 5 times lower than NRC's guidelines. In addition, since 1970 EPA has been mandated to develop residual radiation standards. EPA began to develop these standards in 1984 but does not expect to finalize them until 1992.

Need for Federal Residual Radiation Standards

EPA is responsible for setting off-site radiation dose limits and developing residual radiation standards to protect public health and safety and the environment. Although EPA started to develop residual radiation standards in 1984, it does not plan to finalize them until 1992 at the earliest. As a result, licensees are decommissioning their facilities using NRC regulations and guidance that could change once EPA promulgates its standards.

NRC's radiation protection regulations are primarily set out in 10 CFR Part 20, Standards for Protection Against Radiation, which apply to both operating and decommissioning a nuclear facility. The regulations set exposure rates of 500 millirem (mrem)[1] per year for the maximally exposed individual and 170 mrem per year for the general public. As of May 1989, NRC's commissioners were reviewing a revision to 10 CFR Part 20 that would lower exposure rates for the public to 100 mrem per year. However, if reasonable to do so, NRC suggests that the owners and/or operators of nuclear facilities reduce exposures below NRC guidelines and requires them to comply with EPA's public exposure limit of 25 mrem year during decommissioning activities.

NRC's policies implementing the regulations are found in regulatory guides, general guidance, or internal memoranda. For example, Regulatory Guide 1.86 for nuclear power plants and Annex C for fuel cycle licenses set residual contamination levels for surfaces of equipment and facilities. The guides do not relate contamination levels to exposure rates for the public because NRC considers them to be sufficiently low to

[1]Rem (Roentgen Equivalent Man) is a measurement used to quantify the effects of radiation on man. A millirem is a thousandth of a rem.

be of negligible significance to public health and safety, yet practical to attain and measure. For soil contamination, NRC uses a 1981 branch technical position for the safe storage and/or disposal of uranium and thorium as well as a 1981 internal memorandum for allowable concentrations of americium-241—a highly toxic, cancer-causing radioactive material.

To estimate exposure, a number of factors must be considered. These include the type of radioactive material, length of exposure, and part of the body receiving the exposure. Although the effects of large radiation doses are well known, considerable controversy exists over the risks associated with long-term or continual exposure to small doses of radiation. As a result, different federal agencies use various criteria. For example, NRC uses 500 mrem/year as the maximum whole body dose that an off-site individual could receive; by contrast, EPA uses 25 mrem/year. In addition, other criteria exist for radiation doses to various organs, such as the lungs, gonads, and thyroid.

When commenting on NRC's 1988 decommissioning rule, many organizations pointed out that a need exists for the federal government to develop consistent residual radiation standards. For example, the Electric Power Research Institute stated that a great deal of uncertainty exists for a utility to determine levels of residual radioactivity that will be allowed when NRC releases a site for unrestricted use. In addition, some of those commenting suggested levels for NRC's consideration. The Public Citizen Environmental Action group, for example, wanted NRC to establish a maximum whole body dose of 10 millirems per year. Likewise, the preamble to NRC's decommissioning regulations states that many have expressed concerns about the lack of residual radiation limits and urged NRC to develop such levels as quickly as possible.

In addition, prior GAO reports have addressed the need for federal residual radiation criteria. In 1977, we pointed out that a decommissioning strategy could not be developed until NRC established acceptable residual radiation limits.[2] As a result, we recommended that NRC determine acceptable levels for residual radiation and surface contamination consistent with standards being developed by EPA. In 1982, we again pointed out that radiation standards are needed to guide decommissioning programs.[3]

[2]See EMD-77-46, June 16, 1977.

[3]See EMD-82-40, May 25, 1982.

At that time, we noted that standards prescribing acceptable levels of residual radiation are needed to identify appropriate cleanup methods, their costs, and the amounts of radioactive waste to be disposed of to protect the public from unacceptable risks. We also pointed out that licensees were concerned that they may have to conduct additional cleanup activities if final EPA residual radiation standards are more stringent than those used by NRC. Conversely, if EPA's final standards are less stringent than NRC's, the licensees may have conducted unnecessary cleanup and incurred unneeded costs. As a result, we recommended that EPA reevaluate the low priority it assigned to developing radiation standards and present a plan to responsible congressional committees for issuing them. We also suggested that the Congress transfer responsibility for setting certain radiation standards from EPA to NRC. EPA disagreed and stated that such action would further delay developing the standards.

Nevertheless, 12 years after we first recommended that a need exists for governmentwide residual radiation standards, none exist. On June 18, 1986, EPA published in the Federal Register an advanced notice of proposed rulemaking to develop the standards. In the notice, EPA states that the cleanup of contaminated soil and facilities should be such that the sites may be used without any restrictions. NRC is participating in an interagency working group organized by EPA to develop federal guidance regarding acceptable residual radiation levels that would permit property to be released for unrestricted use. According to the project leader for this effort, EPA probably will not publish a final rule for comment until 1991, and the rule would not take effect until 1992 at the earliest. According to NRC staff, they are not going to wait for EPA to finalize its standards and have been developing residual radiation limits for about 250 substances that can remain in the soil and on surfaces and structures. The staff estimate that they will present their proposal to the commission by December 1989.

Although EPA has not issued residual radiation standards, in November 1977 EPA proposed such standards for plutonium that would have set a maximum dose to the lungs and bone of 1 millirad[4] and 3 millirads per year, respectively. According to the project leader, EPA never finalized the regulations because of politics and hierarchy delays. In addition, in October 1983 EPA issued standards for acceptable concentrations of radium and thorium at uranium mill tailing sites. For both substances, the amount of radioactive material from the top 6 inches of soil cannot

[4]A rad is measure of radiation dose. A millirad is equivalent to one-thousandth of a rad.

exceed 5 picocuries per gram and 15 picocuries per gram for 6 inches of soil below the first level.

NRC and EPA are not the only organizations concerned about residual radiation levels. In 1971 the Health Physics Society Standards Committee, working with ANSI, established a subcommittee to develop permissible levels of residual radioactivity on materials, equipment, and facilities. For 16 years, the subcommittee debated the appropriate residual radiation levels for more than 18 substances, met with government and industry representatives, and reviewed available documents on the long-term effects of radiation. In December 1986, the subcommittee approved residual radiation standards for surface contamination (ANSI N13.12); ANSI has not yet approved them. In January 1989, ANSI asked the subcommittee to analyze the effects of the proposed standards on exposures to the public. According to an ANSI official, the subcommittee is to complete its review by March 1991.

Some of the proposed standards are lower or higher than NRC's regulatory guides. For example, acceptable residual radiation levels for transuranics,[5] radium-226, radium-228, strontium-90, iodine-125, and iodine-129 range from 3 to 50 times higher than NRC's limits, while others, such as natural uranium, uranium-235, and uranium-238, are 3 to 5 times lower than NRC's limits. Overall, the largest change in the proposed standards would be a 50-fold increase in acceptable levels of iodine-125 and iodine-129.

According to NRC staff, they based Regulatory Guide 1.86 on ANSI standards that had been proposed in 1974. The health physics committee chairman responsible for developing the new standards told us that a number of factors have changed since then. For example, the committee now believes that uranium is more harmful than it did in 1974. The chairman agreed that NRC's guidance is based on proposed ANSI or Health Physics Society standards that never made it through the ANSI approval process because of their controversial nature. According to the chairman, no guarantee exists that ANSI will approve the new standards, but he believes they represent achievable limits and are more appropriate than the limits NRC now uses for decommissioning nuclear facilities.

[5]Man-made radioactive elements that remain hazardous for thousands of years.

Monitoring of Buried Waste Needs to Be Improved

NRC does not generally require licensees to monitor groundwater or soil contamination from buried waste during the time a facility operates or after NRC terminates a license. NRC staff do not believe that the buried waste has caused significant environmental contamination. Until January 1981, NRC allowed all licensees to bury radioactive waste on-site without prior NRC approval. Five of the eight licensees that we reviewed buried waste—in four cases neither NRC nor the licensees has complete information on the location of the buried waste or the substances or amounts buried. In one case, NRC terminated a license and 10 years later learned that the licensee had buried waste at the site.

In addition, all five licensees have found groundwater contaminated with radioactive substances. At one site, the contamination was 400 times higher than the levels that EPA's drinking water standards allowed and at another, 12 to 96 times higher. Another site had groundwater contamination 730 times higher than the levels that EPA's drinking water standards allowed, but available documentation did not state if the contamination resulted from buried waste or other activities.

Further, NRC staff believe they can require additional cleanup activities after terminating a license because the Atomic Energy Act authorizes NRC to take actions it considers necessary to protect public health and safety. However, the Commission's regulations do not address the actions that NRC could take against a former licensee. According to NRC staff, they believe it would be very difficult to force a former licensee to clean up future contamination without regulations allowing NRC to take such actions. As a result, the staff plan to propose regulations to implement NRC's authority in this area; they could not estimate when they would do so.

NRC Regulations Do Not Require Soil or Groundwater Monitoring

According to NRC staff, they generally do not require fuel cycle facility licensees to monitor either soil or groundwater contamination from buried waste during the time a facility operates or decommissioning activities occur. NRC does require licensees to monitor air emissions, water effluent, and soil contamination (10 CFR 70.22(a)(7)(8)) during the time a facility operates, but these requirements apply to radioactive releases from plant operations rather than to releases that occur from specific waste disposal areas. According to NRC staff, the regulations preclude terminating a license until NRC has assurance that soil contamination is within NRC release guidelines. However, NRC has no similar requirement concerning groundwater contamination.

Between 1957 and January 1981, NRC allowed all licensees to bury radioactive waste on-site without prior NRC approval (10 CFR 20.304). Five fuel cycle licensees disposed of waste in this manner. However, NRC imposed only minimal requirements for on-site burial and did not set concentration limits. Rather, the regulations provided that a licensee could bury waste if the

- total quantity of each burial did not exceed 1,000 times the amounts specified in the regulations for various radioactive material; for example, the limit on americium-241 and plutonium-239 was 0.01 microcurie;
- waste was buried 4 feet or more below the surface; and
- burials were at least 6 feet apart, and the number of burials did not exceed 12 in any year.

The regulations did not, however, require the licensees to provide burial records to NRC. As a result, NRC has limited information on the types and amounts of waste buried. Although the regulations required the licensees to retain this information, our review of NRC's files and information provided by NRC staff for five licensees shows that four either did not keep these data or they are incomplete. In one case, NRC terminated a license and 10 years later learned that the company had buried waste on the site. The following describes this case.

Westinghouse Electric Corporation

NRC terminated a license (SNM-338) with Westinghouse in 1974. In June 1984, a Westinghouse employee telephoned NRC stating that radioactive waste had been buried at the Cheswick, Pennsylvania, site. Westinghouse still operates the site under another NRC license and subsequently found three buried waste sites—one was underneath an employees' softball field. Although the company had no records showing the number of burials that occurred, types and amount of substances buried, or part of the process that generated the waste, officials believe the disposal in one area occurred in 1966. However, the officials do not know when the other burials took place.

Westinghouse excavated the waste and found (1) 55-gallon drums containing waste solutions, sludge, gloves, and building rubble in one area, (2) building rubble in another, and (3) plastic bottles, duct work material, and building rubble under the ballfield. According to NRC staff, they do not plan to take any enforcement action against the company because Westinghouse is taking corrective action by removing the waste and sending it to an NRC-licensed disposal site.

However, no certainty exists that Westinghouse discovered all previously used burial sites. According to company officials, they do not know whether all buried waste sites have been found, but they are taking steps to make this determination. For example, the company has been digging up parts of the facility that have the highest potential as buried waste sites, such as areas located near buildings or in close proximity to the three sites already found. Despite the lack of disposal records, Westinghouse officials do not believe that the waste posed an environmental or health and safety concern and could have safely been left on the property.

NRC Policy Change

In 1978, NRC staff recommended that the Commission change the regulations and require licensees to obtain NRC approval before burying waste. According to the staff, this change would allow NRC to better protect public health and safety by encouraging licensees to send radioactive waste to an NRC-licensed disposal site and improve NRC's knowledge about the types, amounts, and locations of the buried waste. The staff made this recommendation because several states had expressed concern about the risks associated with licensees' burying radioactive waste without prior NRC notification or approval. NRC agreed with the states and on October 30, 1980, amended its regulations by deleting Section 10 CFR 20.304; the regulations took effect on January 28, 1981.

Under the revised regulations, licensees can still bury waste, but they have to obtain NRC's approval to do so. In addition, the licensees must provide NRC with a description of the (1) quantity and types of materials, (2) levels of radioactivity, (3) proposed disposal method and an environmental analysis of the topography, geology, and hydrology, (4) ground and surface water use in the area, and (5) procedures to minimize the risk of unplanned releases and/or exposures.

Environmental Degradation From Buried Waste

NRC does not generally require licensees to monitor groundwater contamination from buried waste sites. Nevertheless, NRC staff do not believe that any contamination from, or movement of, the waste occurs. NRC bases its position on radiological surveys conducted at Babcock and Wilcox's Parks Township, Pennsylvania, facility; Combustion Engineering's site at Hematite, Missouri; and NFS' site at Erwin, Tennessee, between December 1982 to September 1987. These surveys showed that no significant migration of the buried waste had occurred, and the buried materials were essentially stable. According to NRC staff, a low

probability exists that buried waste has or will contaminate groundwater because of the waste form (solid). The staff stated that they are more concerned about the potential for migration of radioactive waste from previously used ponds or lagoons.

Although NRC staff are generally not concerned that buried waste can migrate, evidence exists that buried waste can present environmental and/or health and safety problems. For example, a 1976 report by the Electric Power Research Institute stated that plutonium, because of its long half-life, must be regarded as a permanent contaminant, although it migrates very slowly. In addition, the coauthor of a 1980 report, Identification of Technical Problems Encountered in the Shallow Land Burial of Low-Level Radioactive Wastes, told us that the possibility for migration of radioactive wastes increases depending on soil composition and the amount of rainfall experienced. According to the report, water seeped into burial trenches at 6 of 11 commercial and government low-level waste sites, and the operators had to temporarily close 2 because of the problems found. Also, in August 1988 we reported that buried waste can (1) migrate into rivers and streams, (2) migrate into groundwater supplies, or (3) inadvertently be disturbed by people or animals.[1]

In addition, iodine-129 from defense production waste buried on DOE's Hanford Reservation in Washington State has migrated to the groundwater, and hazardous waste buried at DOE's Savannah River, South Carolina, plant has contaminated an aquifer underlying the site. Further, a study has shown that radioactive waste that also contains hazardous chemicals can migrate faster than radioactive waste alone. Some fuel cycle operations may have used hazardous chemicals, such as solvents and leachates. Five of the eight licensees we reviewed buried waste onsite; five have found groundwater contaminated with radioactive substances. Four of the cases are discussed below.

Nuclear Fuel Services, Inc.

NFS used three burial sites and three ponds to dispose of radioactive waste. Although the company had some records showing the types and amount of waste disposed, the records were not complete. For example, one burial site had two trenches, but NFS does not have information showing when it used the trenches, a description of items disposed, or the radioactive material or quantities in the waste. NFS subsequently removed much of the waste from the trenches, decontaminated it, and sold it to a local organization.

[1] Problems Associated With DOE's Inactive Waste Sites (GAO/RCED-88-169, Aug. 3, 1988).

For another disposal site, however, neither NFS nor NRC knows the types and amounts of substances buried in it. According to company officials, they believe that natural uranium or thorium, not enriched uranium or plutonium, was disposed of at this site. NFS plans to address the possibility of cleaning up the burial site at a later date, but company officials could not estimate when this would occur. According to NFS officials, they believe the waste was buried by the previous owner of the site and was "probably" allowed under a state permit. NRC staff said they have no record of a previous owner; NRC issued NFS a license in the late 1950s.

Because NFS did not have complete solid or liquid waste disposal records, in October 1983 NRC required NFS to take monthly samples from 14 groundwater monitoring wells to determine the radioactive and hazardous substances they contain. Sample results in 1987 showed radioactive contamination in six wells that was higher than EPA's drinking water standards allowed. In one well, the contamination was 730 times higher. NFS could not determine if the contamination was from the buried waste sites or other plant operations. To make this determination, NFS installed 22 additional monitoring wells.

Further, in 1986 NRC contracted with ORAU to characterize the substances in NFS' buried waste sites, determine the possibility for waste migration, and assess the environmental impacts that could occur from such migration. In its September 1987 report, ORAU pointed out that buried waste had resulted in significant soil and some groundwater contamination. Although the buried waste did not pose any danger, ORAU said that contamination could migrate off-site through storm runoff and other activities that disturb the surface soil.

Combustion Engineering, Inc.

In 1982, NRC contracted with Radiation Management Corporation to conduct a radiological survey of the burial waste site at Combustion Engineering's Hematite, Missouri, facility. In a July 1983 report, NRC confirmed that small quantities of uranium (uranium-235, uranium-238, and uranium-234) had been buried at the facility. NRC's soil samples showed contamination that was 40 times higher than its guidelines for uranium-234 allow. In addition, samples from two groundwater monitoring wells appear to show some contamination from the burial sites that ranged from 1 to 12 times higher than EPA's drinking water standards allow—earlier sample results appear to show contamination from the ponds and/or the burial sites that was 96 times higher than EPA's drinking water standards allow. The report also pointed out that all buried

waste sites may not have been identified and/or surveyed because Combustion Engineering did not have complete information on the number or locations of the sites. Further, the report stated that locating low-level buried waste is almost impossible when using only surface measurement techniques.

Cimarron Corporation

Cimarron Corporation, owned by Kerr-McGee Nuclear Corporation, received a license around 1965 to fabricate uranium fuel and in 1970 to fabricate plutonium fuel. Cimarron used five settling ponds and a burial site to dispose of radioactive waste generated from its uranium/plutonium operations. The burial area included four trenches. In 1985 the company began to excavate, package, and ship the waste to an NRC-licensed disposal facility. As of January 1989, Cimarron had removed more than 6,400 drums of waste and plans to complete the removal process by 1991. Cimarron's environmental monitoring reports between 1985 and 1987 showed groundwater contamination from the burial area that was between 208 and 360 times higher than EPA's drinking water standards allow. In June 1988, NRC recommended that the company obtain additional information about the groundwater under the site. In August 1988, ORAU found groundwater contaminated from the buried waste to be as much as 400 times higher than EPA's drinking water standards allow.

Texas Instruments, Inc.

Until 1959, the Texas Instruments, Inc. (TI) facility, located about 30 miles south of Boston, Massachusetts, was owned and operated by Metals and Controls, Inc. In 1955 the company received a license to fabricate fuel for research reactors and in 1959 merged with TI, which continued these operations under the same license. The company stopped all licensed activities and in 1982 asked NRC to terminate the license. As of May 1989, NRC had not done so.

In January 1983, TI provided NRC with a radiological survey report to support its termination request. The report showed that waste had been buried on the site between 1958 and 1960 but that the radioactivity was below NRC's release limits. In December 1983, NRC requested ORAU to survey portions of the site. ORAU found isolated areas of soil contamination and groundwater contamination that was more than six times higher than EPA's drinking water standards allow.

NRC Lacks Regulations to Require Cleanup After Terminating a License

According to NRC staff, if they terminate a license and subsequently find buried waste sites or contamination above levels that NRC guidelines allow, they believe that NRC can require the company to conduct additional cleanup activities because section 161 of the Atomic Energy Act authorizes NRC to take actions it considers necessary to protect the public from the hazards of radioactive materials. According to NRC's Office of General Counsel staff, the Commission, under the broad discretion granted by section 161, can issue orders requiring additional cleanup after terminating a license. However, NRC does not have regulations implementing that authority and specifying the enforcement actions that can be taken once it has released a site for unrestricted use and terminated the license. Therefore, the staff believe that enforcing corrective actions on a former licensee without regulations would be difficult. As a result, NRC plans to draft regulations to implement its general authority. The staff could not estimate when they would publish the proposed rules for public comments or when a final rule could be expected. In the past, however, NRC has taken a long time to issue regulatory changes. For example, NRC took over 10 years to issue new decommissioning regulations.

Conclusions and Recommendations

Conclusions

Only very limited decommissioning activities have occurred at large commercial nuclear power plants because no disposal facility exists for the high-level waste generated from their operations. Instead, utilities expect to partially decontaminate the plants and place them in storage for several decades to allow the radioactive material to decay. However, the same is not true for fuel cycle facilities. Some operators of these facilities have fully decommissioned some or all of their sites or are now decommissioning them.

Although only one fuel cycle facility that we reviewed had been completely decommissioned, the activities that have occurred with others provide some perspective on the manner in which NRC carries out its regulatory responsibilities in this area. In this regard, we found a number of areas in which NRC can play a stronger role in ensuring that all land, buildings, and equipment that it releases for unrestrictive use meet the guidelines that it has established.

For example, NRC can provide only limited assurance that licensees have fully decontaminated their facilities and accurately reflected the results of these activities in their radiological surveys. NRC and ORAU confirmatory surveys show that in many instances, excessive radiation remained after the licensees' completed initial decontamination activities. In some cases, the contamination was hundreds of times higher than NRC allowed. In other cases, the licensees did not, as regulations require, make a reasonable effort to decontaminate their facilities below the levels that NRC's guidelines allowed.

In addition, NRC does not require licensees to keep decommissioning records after it terminates a license. Although NRC is required to keep such information for at least 10 years beyond the termination of the license, NRC either did not have such information or the records that it did have were incomplete or ambiguous. Since both the Pawling and Westinghouse cases illustrate that problems can occur many years after NRC terminates a license, NRC must ensure that it obtains and keeps information on licensees' decommissioning activities.

Also, no federal standards exist for acceptable levels of radioactivity that can remain after NRC releases a site for unrestricted use. The need for such standards was raised almost 20 years ago. To date, neither NRC nor EPA has resolved the issue. In the interim, NRC uses criteria developed in the early 1970s. Since that time, the Health Physics Society Standards Committee has concluded that some radioactive materials are more hazardous than experts believed 15 years ago. The lack of federal

standards also raises the specter that decontamination activities conducted today may not meet requirements set in the future. Thus, nuclear facility owners and operators should decontaminate their facilities not only to meet NRC's guidelines but also to comply with its guidance to reduce contamination below the guidelines if reasonably achievable to do so.

Further, many fuel cycle facility licensees buried radioactive waste onsite. However, in four of the five cases that we reviewed, neither NRC nor the licensee had comprehensive information on the location or the types and amounts of substances buried. Further, although NRC does not believe the buried waste has caused environmental damage, five sites have groundwater contamination in excess of federal drinking water standards. For four of the sites, the contamination appears to have come from the buried waste. Further, licensees' monitoring programs are generally not sufficient to define radiological conditions within the buried waste in the future. Therefore, NRC should require licensees either to (1) monitor and/or characterize the waste while the facility operates or (2) conduct a thorough radiological survey before releasing a site for unrestricted use or terminating a license. In addition, requiring licensees to monitor groundwater and soil around the buried waste will give NRC a better basis to decide whether to terminate a license. Without such information, NRC cannot provide the public with reasonable assurance that the remaining contamination is safe enough for unrestricted use.

Recommendations to the Chairman, NRC

To enhance NRC's regulatory oversight of nuclear facilities decommissioning efforts, we recommend that the Chairman, NRC,

- require licensees to specifically list in one document all land, buildings, and equipment involved with their licensed operations;
- ensure that the licensees decontaminate their facilities in accordance with NRC's guidelines before NRC fully or partially releases a site for unrestricted use;
- determine if NRC's residual radiation criteria should be revised on the basis of the standards proposed by the Health Physics Society Standards Committee;
- ensure that licensees appropriately monitor buried waste sites to determine the extent of environmental contamination; and
- ensure that NRC obtains and keeps for more than 10 years decommissioning information such as licensee radiological surveys and certification of materials disposed, NRC's or other organizations' confirmatory surveys,

and specifics on land, buildings, and equipment that were contaminated over the life of the license.

In addition, since NRC believes that it has authority to require additional cleanup activities after terminating a license and to ensure that it has a mechanism to enforce orders requiring such activities, the Chairman, NRC, should act expeditiously to issue regulations governing such actions. In the interim, the Chairman should also ensure that all contamination at a site has been cleaned up so that it is below the levels that NRC's guidelines allow before releasing all or part of a site for unrestricted use.

Information on Eight Fuel Cycle Facilities

Cimarron Corporation, Crescent, Oklahoma

The Cimarron Corporation facility, located on about 1,000 acres in central Oklahoma, is owned by the Kerr-McGee Nuclear Corporation. Cimarron received a license around 1965 to fabricate uranium fuel (SNM-928) and in April 1970 to fabricate plutonium fuel (SNM-1174). To dispose of the radioactive waste generated by these operations, Cimarron used five settling ponds (two unlined and three lined) and a small burial site (about 1 acre), and around 1979 built a sanitary lagoon over three of the settling ponds that had been used to dispose of radioactive waste. In the fall of 1975, Cimarron decided to terminate all operations at the site. Since that time, the company has decontaminated and NRC has released parts of the facility for unrestricted use. As of May 1989, NRC had not terminated the licenses.

NRC's files show that the company stopped using the five ponds in December 1975. The company allowed the liquid to evaporate, removed the remaining sludge and mixed it with cement, and sent it to an NRC-licensed waste disposal site. In addition, after removing the sludge, Cimarron analyzed the top 6 inches of soil in the ponds. In August 1977, the company provided NRC with a plan for releasing the five ponds by backfilling them with dirt. On July 10, 1978, NRC authorized Cimarron to take this action and released the ponds for unrestricted use.

According to NRC staff, they did not observe the licensee backfilling the ponds, and they had no criteria for the levels of radioactivity that could remain after the company decommissioned the ponds. In October 1981, NRC issued guidelines for decommissioning soil contaminated with uranium and thorium. Available documentation shows that radioactive contamination in 2 ponds ranged from 6 to 10 times higher than the guidelines allowed. Cimarron does not plan to take further actions on the ponds because NRC released them before issuing the guidelines, but company officials told us that they may include disposal information when they prepare a final decommissioning plan for the site.

In addition to the ponds, from 1966 to 1970, Cimarron buried radioactive waste that had been generated in the uranium facility. The burial area included at least four trenches. Although Cimarron disposal records showed the date, type of waste, and levels of radioactivity for each burial, they did not specify the trenches in which the waste was buried. In 1985 the company began to excavate, package, and ship the waste to an NRC-licensed disposal facility. As of January 1989, Cimarron had removed more than 6,400 drums of waste from four trenches and plans to complete the removal process by 1991. However, the company has not removed all contaminated soil in or around the trenches.

As a result, in September 1987, Cimarron submitted a license amendment application to NRC that addressed specific options for the contaminated soil. The company proposed to (1) leave soil in place that contains uranium and thorium that are at levels below NRC's guidelines, (2) move to a designated on-site area about 400,000 cubic feet of soil that exceeds NRC's guidelines, and (3) leave about 3 million cubic feet of soil that is more than 4 feet below the surface in place. If the company can demonstrate that the soil will not contaminate the groundwater, NRC's guidelines allow the company to take the proposed actions, and NRC could release the property for unrestricted use. However, Cimarron's environmental monitoring reports between 1985 and 1987 show groundwater contamination from the burial area that was between 208 and 360 times higher than EPA's drinking water standards allow. Further, a June 1988 NRC inspection report recommended that the company obtain additional information on the groundwater under the site. Also, samples taken by ORAU in August 1988 showed that groundwater contamination from the buried waste was as much as 400 times higher than drinking water standards allow. As of May 1989, NRC had not approved Cimarron's plan for the contaminated soil.

By December 1989, the company expects to complete all decontamination activities at the site and ask NRC to terminate the license. In the process, the company would decontaminate both the plutonium and uranium buildings and two lagoons that had received wash, shower, sanitary, and laundry water during the time the facility operated. Since sediment samples from the lagoons show radioactive contamination that is more than 40 times higher than NRC's guidelines allow, the company plans to remove the sediment and send it either to an NRC-licensed disposal facility or a designated on-site burial area.

Combustion Engineering, Inc., Hematite, Missouri

The Combustion Engineering, Inc. (CE) facility is located about 35 miles south of St. Louis, Missouri, and is the oldest commercial reactor fuel production plant. Since 1956, NRC has licensed five companies to operate the facility—Mallinckrodt Chemical Works, from 1956 until 1961; United Nuclear Corporation, from 1961 until 1971; Gulf Oil Company, from 1971 until 1973; Gulf Nuclear Fuel Corporation, from 1973 until 1974; and CE, from March 1974 to the present to produce high- and low-enriched uranium fuel and conduct other activities. In January 1979, CE submitted a site decommissioning plan to NRC. However, the plan was not complete; it did not discuss the need to clean up buried waste sites, liquid waste disposal ponds, or contaminated limestone rock and soil that are present at the site.

Nevertheless, in 1974 the company began decontamination activities at the site. It has decontaminated two warehouse buildings and is decontaminating two liquid waste disposal ponds. It has also been assessing various disposal options for contaminated limestone rock that had been used to filter air emissions and had been used as backfill material at the site.

In the late 1950s and early 1960s, both Mallinckrodt and United Nuclear buried small quantities of uranium waste within the licensed boundaries of the site. However, neither CE nor NRC have specific information on the size of the burial area, the number of trenches it contained, or the amount and types of substances disposed in them. In 1982 NRC contracted with Radiation Management Corporation to survey the buried waste site. In July 1983, NRC reported that (1) three types of uranium (uranium-234, uranium-235, and uranium-238), radium, and thorium waste had been buried, (2) soil samples showed uranium-234 contamination that was 40 times higher than NRC's guidelines allow, and (3) samples from two on-site groundwater-monitoring wells appeared to show that contamination from the burial grounds ranged from 1 to 12 times higher than EPA's drinking water standards allow. The report also concluded that all sites may not have been identified and/or surveyed because CE did not have complete information on the number or locations of burial sites.

In addition to buried waste, until 1978, CE used two settling ponds for handling radiological liquid wastes from its processing operations. The company allowed the liquid to evaporate and has been removing the remaining sludge and dirt from the ponds. CE plans to send the sludge and soil to an NRC-licensed disposal site. Once these activities are complete, the remaining contamination is expected to be between six and seven times higher than NRC's guidelines for releasing soil for unrestricted use. As a result, the company plans to cover the ponds with clean fill dirt to bring the contamination closer to NRC's guidelines for unrestricted release. However, NRC documents indicate that the two ponds and/or the burial grounds have contaminated the groundwater under the site. For example, samples taken in 1977 and 1978 from two on-site groundwater monitoring wells appear to show contamination from the ponds and/or burial grounds that was 96 times higher than EPA's drinking water standards allow.

In a related matter, in 1979 NRC authorized CE to use limestone rock chips to filter corrosive gases used in its process before releasing the gas to the atmosphere. NRC also allowed the company to use the stone as on-

site fill material if the radioactive contamination was below background levels. CE used the stone as backfill in two on-site landfill areas and is storing the remainder in two piles on the site.

In 1984 the company instituted a monitoring program to determine whether the limestone presented environmental problems. Also, in 1984 CE asked NRC to allow the company to dispose of some of the limestone in an on-site burial area. NRC did not authorize CE to do so but stated that the limestone should be sent to a licensed disposal facility. According to NRC staff, CE is conducting a study to determine whether on-site disposal of the limestone would meet NRC guidelines.

On October 12, 1988, CE asked NRC to release two warehouse buildings from its license. Along with the request, CE sent NRC the results of its radiological survey for the buildings. The report stated that the remaining contamination in the two buildings was below levels that NRC's guidelines allowed. However, the report did not include information related to contaminated soil around the buildings or contamination that may be present in drainage systems associated with them. On October 31, 1988, NRC released the two buildings but did not release the land around them. CE subsequently submitted information regarding soil contamination and said that the remaining contamination was within levels that NRC's guidelines allowed. ORAU did a confirmatory survey in January 1989 and found five areas where the contaminated soil apparently exceeded levels that NRC's guidelines allowed. CE removed some soil, and ORAU's followup review indicated that CE's actions eliminated or reduced the elevated levels to within levels that NRC's guidelines allowed.

General Electric Company, San Jose, California

GE received a license in 1967 to make fuel for nuclear power plants. The facility, located on 78 acres south of San Jose, California, included a number of buildings but, according to NRC documents, most of the radioactive contamination appeared to have occurred in buildings H and J, which were used to convert uranium hexafluoride gas to a form suitable for fuel and assemble the fuel following the conversion process. NRC terminated the license on August 20, 1985, but, at the same time, transferred responsibility for the license to the state of California. Before the state would accept responsibility, however, NRC required GE to decontaminate buildings H and J and submit its survey results to NRC. However, NRC's files did not contain the survey results. NRC staff did provide us with some draft surveys and a brief NRC summary of GE's final survey for building J. According to NRC's guidelines, the company should have conducted a comprehensive radiation survey to determine the extent of

decontamination and reported its findings to NRC, and NRC should have retained the information.

Between August 1982 and September 1984, NRC surveyed building J or H at least five times. During four of the surveys, NRC identified locations where contamination exceeded its guidelines and required GE to conduct further decontamination. For example, in the J building, GE had to remove interior walls, concrete floors, drainage lines, and portions of the roof. In addition, NRC found some contamination in the H building that was eight times higher than its guidelines allowed. GE reduced the contamination by removing part of the building. Further, NRC collected 13 soil samples and found that 4 contained contamination ranging from 1 to 77 times higher than the guidelines allowed.

In addition to the San Jose location, GE's license covered activities performed off-site. Under NRC's guidelines, GE should have documented that remaining contamination, if any, was low enough for unrestricted use. However, NRC did not have documentation in its files showing whether (1) GE surveyed the off-site locations, (2) NRC inspected them and/or confirmed the survey results, or (3) the levels of contamination that remained when NRC transferred the license to the state were below NRC's release limits.

Gulf United Nuclear Corporation, Pawling, New York

In 1958 Gulf United Nuclear Corporation (GUNC) received a license to fabricate and/or test uranium oxide, thorium, and plutonium fuel in several small research reactors. The facility, located near Pawling, New York, included about 1,170 acres of land, about 9 buildings, and a 55-acre lake (Nuclear Lake). GUNC stopped all operations in 1972 and contracted with Atcor Incorporated to decontaminate and survey the site. After receiving the survey results, NRC inspected the site and performed a confirmatory survey to verify that it could release the site for unrestricted use. NRC took building and soil samples and found several areas that required further cleanup by the licensee. After GUNC notified NRC that the areas had been decontaminated, NRC terminated the license on July 14, 1975.

Subsequently, GUNC sold the site to Harpoon, Inc., which in June 1979 sold the property to the U.S. Department of the Interior's National Park Service for relocating part of the Appalachian National Scenic Trail. After the National Park Service acquired the property, it contracted with Nuclear Energy Services for radiological surveys of portions of the

site. The July 1984 survey report showed residual contamination in one building that was 35 times higher than NRC's guidelines allowed.

After making various studies and reviews, a local group, the Nuclear Lake Management Committee, raised concerns regarding residual contamination in building drains, septic tank and drain systems, and various buildings. The committee was also concerned that radioactive or hazardous wastes may have been disposed of in the lake. To resolve some of these concerns, the National Park Service contracted with ORAU to survey the site.

ORAU found that the contamination in building drains, septic systems, and the lake were within levels that NRC's guidelines allowed. However, ORAU found some small areas of surface contamination in 2 buildings and soil contamination outside 1 building that ranged from about 3 to 320 times higher than levels that NRC's guidelines allowed and over 50 unidentified objects on the lake bottom that needed to be investigated further. However, ORAU took only a few measurements in each building, primarily at locations where previous surveys had shown elevated contamination levels. ORAU's project manager responsible for surveying the site believes that additional contamination would have been found if ORAU had conducted a more in-depth survey.

At about the same time that NRC terminated GUNC's license for the Pawling site, it also released three buildings that had been transferred to GUNC around 1974. In September 1974, GUNC provided its radiological survey results to NRC. The survey, however, addressed only parts of two buildings (19H and 50H). NRC's files included no information on the third building (41H), which had been used to ship, receive, and store radioactive material. In addition, two other locations (Eastview and White Plains, New York) were places of authorized use under NRC's license. However, NRC's files did not contain the licensee's radiological survey or a confirmatory survey by NRC for the Eastview and White Plains facilities.

Nuclear Fuel Services, Inc., Erwin, Tennessee

NFS received a license in 1958 to convert uranium hexafluoride gas to fuel for commercial and naval reactors, fabricate various materials using thorium, recover both uranium and thorium from the processes conducted, and produce plutonium fuel. The facility covers 58 acres in eastern Tennessee and includes over 20 buildings as well as 3 ponds and 3 burial sites, which had been used to dispose of liquid and solid low-

level radioactive waste, respectively. Between 1958 and 1968, NFS discharged liquid uranium and thorium waste to holding ponds, which, in turn, discharged the clarified solution to a small stream (Banner Spring) that flowed through the site. The stream also flowed through property owned by the Clinchfield Railroad. In 1968 NFS diverted the flow of Banner Spring.

In 1973 NFS stopped using the plutonium facilities and began to decommission them in the late 1970s. NFS later stopped these activities because no commercial disposal site was available for the transuranic waste resulting from the decommissioning activities. In 1986 DOE and NFS reached an agreement to send the waste to DOE's Idaho National Engineering Laboratory. As a result of the agreement, NFS resumed decommissioning activities on the plutonium facilities; the company expects to complete these activities by 1992.

In 1978 NFS initially prepared a plan for the future decommissioning of 18 buildings used to process high- and low-enriched uranium. According to the plan, the company expects to eventually remove about 310,000 cubic feet of contaminated material representing approximately 450 shipments to an NRC-licensed disposal site, probably Barnwell, South Carolina. The company has started to decommission three buildings and is deciding the most appropriate method to decommission three unlined ponds that had been used from 1958 until 1978 to dispose of liquid low-level waste from various plant operations. According to NRC's Executive Director for Operations, NFS has been working closely with NRC and the state and expects to provide a decommissioning plan for the ponds by July 1989.

To develop the decommissioning plan, NFS will use information from its monitoring program. In October 1983, NRC required NFS to take monthly samples from 14 groundwater monitoring wells to determine the radioactive and hazardous substances they contain. Sample results in 1987 showed radioactively contaminated groundwater in six wells at levels higher than EPA's drinking water standards allow. In one well the contamination was 730 times higher than these standards. Although the wells were located to monitor waste migration from the ponds and burial sites, NRC found that they did not do so. As a result, NRC required NFS to upgrade its monitoring program by drilling 22 new groundwater monitoring wells. Most of the wells were located near the ponds; NFS completed the wells in the fall of 1986.

NFS also has three solid waste burial sites—two on its property and one on property owned by the Clinchfield Railroad and leased to NFS. The main burial site, located in the northeast corner of NFS' property, contains about 26 trenches; 21 were used to dispose of radioactive waste. The area is covered with grass and trees. At the second site, NFS has found radioactive contamination that company officials believe is natural uranium or thorium. However, NFS does not have information showing the type of waste buried at the site. The third burial site, located on Clinchfield's property, contains two trenches that NFS used in 1969 to dispose of contaminated metal. The company later removed the metal, decontaminated it, and sold it as scrap. In September 1987, ORAU found uranium contamination and some contaminated debris at the site that exceeded NRC's guidelines.

In 1986 NRC contracted with ORAU to characterize the substances in the buried waste sites, determine the possibility for waste migration, and assess the environmental impacts that could occur from such migration. In its September 1987 report, ORAU points out that some of the buried waste had migrated and contaminated the groundwater. Soil samples taken from the periphery of the burial sites indicated that the buried waste had not migrated off-site. However, ORAU pointed out that the potential existed for the contamination to migrate off-site in the future through storm runoff or other activities that would disturb the surface soil.

Since 1980, NRC has been releasing some of the land identified in NFS' license. In 1980 NFS notified NRC that it wanted to release some land that included the stream bed of the Banner Spring before NFS diverted its flow. NFS conducted a radiological survey of the old stream bed on Clinchfield's property. The survey concluded that the level of contamination in the soil was within NRC's guidelines. However, NRC's confirmatory survey found contamination that was between 1.5 and 4.4 times higher than its guidelines allowed. Nevertheless, NRC released about 36,250 square feet of land adjacent to Clinchfield's property for unrestricted use. NRC documents show that a number of factors caused NRC to release the land prior to NFS' taking actions to remove the contaminated soil. For example, NRC concluded that (1) its guidelines merely set a "target" value rather than an absolute value that must be achieved, (2) the contaminated soil would be covered with approximately 7 feet of dirt, essentially eliminating the exposure pathway, and (3) the average concentration of the contaminated soil was within NRC's guidelines.

In 1984 NFS asked NRC to release additional land from its license. Again the land was on the Clinchfield property and the site of the old Banner Spring stream bed. NFS surveyed the property and found that, with the exception of one area, the soil contamination met NRC's release guidelines. On July 24, 1987, NRC released the land even though a small portion exceeded NRC's guidelines for unrestricted use—the contamination was about three times higher than NRC's guidelines allowed, and NRC did not require NFS to remove the contaminated soil. According to an NRC document supporting the release, NRC concluded that the contamination level was low and would not adversely affect public health and safety because the land was used by the railroad only.

Texas Instruments, Inc., Attleboro, Massachusetts

Until 1959, the Texas Instruments, Inc. (TI) facility, located about 30 miles south of Boston, Massachusetts, was owned and operated by Metals and Controls, Inc. In 1955, the company received a license to fabricate fuel for research reactors. In 1959, the company merged with TI, which continued these operations under the same license.

In 1968, TI began to cut back its operations. In May 1982, TI requested that NRC terminate the license and release the building used for these activities for unrestricted use. Along with the request, TI submitted a radiological survey to NRC showing that the building met NRC's guidelines. NRC subsequently inspected the building and concluded that the remaining contamination was within NRC's guidelines. In 1983, NRC released the building from the license.

In January 1983, TI asked NRC to release a burial area that had been used to dispose of low-level radioactive waste. According to TI's 1964 health and safety manual, uranium- and thorium-contaminated noncombustible scrap material and machinery were put in 55-gallon drums and buried on-site between 1958 and 1960 under 10 CFR 20.304. TI provided NRC with a radiological survey report to support its request to release the land and terminate its license. The company took test samples of the waste and concluded that the level of radioactivity was so low that no one should receive a radiation dose in excess of 1 millirad per year to the lung or 3 millirads per year to the bone from inhalation or ingestion. These doses are within EPA's radiation protection standards. The report also pointed out that the radioactive material would only be accessible by digging into the soil. As a result, TI concluded that the waste should remain in place and that removing the large volume of contaminated soil (over 160,000 cubic yards) and transporting it to a licensed disposal site would neither be practical nor justifiable for public health reasons.

In December 1983, NRC requested ORAU to survey portions of TI's site. To conduct the survey, ORAU took ground surveys, walkover scans, subsurface water samples, and soil samples to provide a comprehensive assessment of the radiological conditions on the site. ORAU's 1985 report showed isolated areas of surface and subsurface contamination. The contamination occurred primarily within the burial site and around the building that had been used to fabricate the research reactor fuel. In addition, ORAU found groundwater contamination that was more than six times higher than EPA's drinking water standards allow.

United Nuclear Corporation, New Haven, Connecticut

UNC received a license on February 28, 1969, to fabricate fuel for the naval reactor program at two sites: New Haven and Montville, Connecticut. The New Haven site included about 12 buildings; the Montville site encompassed about 235 acres on the Thames River about 50 miles northeast of New Haven. UNC stopped operating the New Haven facility in 1975 and continues to operate the Montville site and use other authorized locations. According to UNC documents, the company used at least 16 different buildings at the various sites—the initial license did not specify these locations but rather stated that the New Haven site was the "authorized place of use." However, in a 1964 license amendment, NRC specifically listed four buildings and a storage vault.

According to available documentation, UNC decontaminated many of its buildings and land at New Haven and other locations in 1975 and 1976 and provided NRC with radiological surveys for some of them. However, the company did not survey one building listed in the 1964 license amendment. In addition, UNC's survey report for part of the New Haven facility stated that the company had taken soil samples at five locations and water samples from on-site storm basins. The company did not provide the sample results in its report to NRC but stated that the information would be provided later. NRC's files did not contain this information. Nevertheless, NRC released all the buildings and land for unrestricted use after conducting some inspections to ensure that the residual contamination was within NRC's guidelines.

Westinghouse Electric Corporation, Cheswick, Pennsylvania

In 1959 Westinghouse Electric Corporation received a license (SNM-338) to fabricate fuel for commercial and research reactors at its Cheswick, Pennsylvania, facility. Westinghouse performed these activities in four buildings—one was later transferred to another license that Westinghouse received from NRC. On August 20, 1974, NRC terminated the license but did not specify either the buildings or land that were released for unrestricted use.

On March 7, 1969, NRC issued Westinghouse a second license (SNM-1120) to perform research and development on mixed plutonium-uranium and uranium oxide fuels. Westinghouse used at least three buildings for these activities. The license is still active although Westinghouse has decontaminated two buildings, and NRC has released them for unrestricted use. Westinghouse used the buildings (7 and 8) to develop and fabricate the fuels. Building 7 was used for about 15 years, contained a plutonium and uranium laboratory, and was originally under license SNM-338. Building 8 was used for about 10 years to produce commercial and breeder reactor fuels on a developmental basis. In addition to the two buildings, NRC released other buildings and land under this license between September 1982 and June 1984.

After NRC terminated license SNM-338 in 1974, three previously unknown buried waste sites were found. According to Westinghouse officials, they have no records showing the number of burials that occurred, types and amount of substances buried, or part of the process that generated the waste. However, they found (1) 55-gallon drums containing gloves and building rubble in one area, (2) building rubble in another, and (3) plastic bottles, duct work material, and building rubble under an employees' softball field. According to NRC staff, they do not plan to take any enforcement action against the company because Westinghouse is taking corrective action by removing the waste and sending it to an NRC-licensed disposal site.

However, no certainty exists that Westinghouse discovered all previously used disposal sites. According to company officials, they do not know whether all buried waste sites have been found, but they are taking steps to make this determination. For example, the company has been digging up parts of the facility that have the highest potential as buried waste sites, such as areas located near buildings or in close proximity to the three sites already found. Despite the lack of disposal records, Westinghouse officials do not believe that the waste posed an environmental or health and safety concern.

Major Contributors to This Report

Resources, Community, and Economic Development Division, Washington, D.C.	Keith O. Fultz, Director, Energy Issues, (202) 275-1441 Mary Ann Kruslicky, Assistant Director Philip A. Olson, Evaluator-in-Charge

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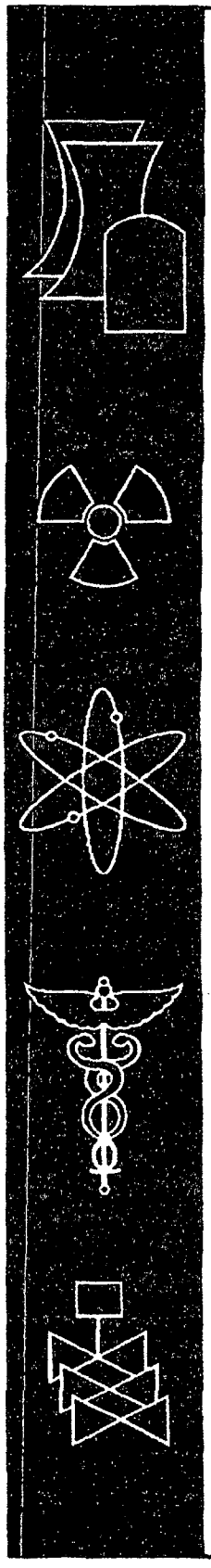
NUREG-0940
Vol. 18, No. 2, Part 3
Material Licensees



Enforcement Actions: Significant Actions Resolved Material Licensees

Loss of SNM

Semiannual Progress Report
July - December 1999

U.S. Nuclear Regulatory Commission
Office of Enforcement
Washington, DC 20555-0001

NOTICE

NUREG-0940, Enforcement Actions: Significant Actions Resolved, has been published since 1982 to provide NRC-regulated industries and the public with information about the more significant enforcement actions taken by the agency. Recently, the development and widespread use of electronic information dissemination has changed the nature of communicating between federal agencies, their licensees, and the public.

The printed version of NUREG-0940 has been published approximately every six months. Thus, given the time needed to prepare, print, and distribute the document, copies of some actions do not reach licensees and others until 8-9 months after issuance. However, all enforcement actions that are published in NUREG-0940 are now posted on the NRC website, under the Office of Enforcement home page, promptly after issuance. See: www.nrc.gov/OE

Accordingly, the NRC has evaluated the effectiveness of using the resources needed to publish the printed version of NUREG-0940. The NRC has concluded that continuing to publish material in hard copy, when that information is currently and more promptly available electronically, is neither an effective use of resources nor consistent with the Congressional mandate to maximize use of Information Technology and is no longer appropriate. Therefore, this issue is the last that will be issued unless the agency receives significant public comment in favor of continued publication. If you wish to comment, send your views, no later than August 31, 2000, to:

R. W. Borchardt, Director
Office of Enforcement (O-14E1)
U. S. Nuclear Regulatory Commission
Washington, DC 20555-

Comments may also be sent electronically to: bts@nrc.gov

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET, SW, SUITE 23T85
ATLANTA, GEORGIA 30303-3415

October 19, 1999

EA 99-218

Nuclear Fuel Services, Inc.
ATTN: Mr. Dwight Ferguson
President
P. O. Box 337, MS 123
Erwin, TN 37650

SUBJECT: NOTICE OF VIOLATION (NRC INSPECTION REPORT NO. 70-143/99-01)

Dear Mr. Ferguson:

This refers to the inspection conducted during the period January 3 through February 13, 1999, at your Erwin facility. The purpose of the inspection was to determine whether activities authorized by the license were conducted safely and in accordance with regulatory requirements. The results of the inspection including three apparent violations were discussed with members of your staff at an exit meeting on February 10, 1999, and formally transmitted to you by letter dated March 19, 1999. Subsequent to the completion of a related Office of Investigations investigation, which did not substantiate deliberate misconduct, a closed, predecisional enforcement conference was conducted at the NRC Region II office in Atlanta, Georgia, on October 12, 1999, to discuss the apparent violations, the root causes, and your corrective actions. A list of conference attendees and a copy of the Nuclear Regulatory Commission's (NRC) presentation material are enclosed. The Nuclear Fuel Services' (NFS) presentation material will provided to the NRC by separate docketed correspondence.

Based on the information developed during the inspection and the information that you provided during the conference, the NRC has determined that three violations of NRC requirements occurred. The violations are cited in the enclosed Notice of Violation (Notice) and the circumstances surrounding them are described in detail in the subject inspection report. Violation A involved a failure to conduct or to conduct adequately two independent visual and detector searches by two individuals for a container removed from a Material Access Area (MAA). The failure resulted in the unauthorized removal of seven grams of Uranium-235 contained in high enriched uranium (special nuclear material (SNM)) from the Building 233 vault (an MAA) to a Building 306 storage area. The SNM was contained in a two-liter bottle inside a 55-gallon drum without a closure lid, and was discovered missing from the vault by your staff on January 11, 1999, during an inventory reconciliation. Violations B and C occurred as a result of Violation A, and involved the unauthorized storage of the 55-gallon drum containing the SNM in a location not approved for SNM storage, and the failure to assure that the movement of this SNM out of the Building 233 vault was properly documented by the material control and accounting system at the facility. Your review of the issue identified the root causes as procedural shortcomings, poor lighting which may have inhibited the proper search of empty containers, security guard training deficiencies, as well as other causal factors.

We recognize there was no actual loss or diversion of SNM, and the quantity was below that defined as low strategic significance. However, the NRC considers this issue to be significant because of the failure of multiple controls designed to prevent the loss, theft, or diversion of SNM. These controls included two procedurally required independent searches by your security personnel, with each independent search consisting of a visual search followed by a detector search for SNM. An additional failed control involved Operations personnel, who did not confirm that the 55-gallon drum was, in fact, empty prior to transfer of the drum containing SNM to the MAA boundary. Confirmation by Operations personnel was not a procedural requirement at the time; however, it nonetheless represented a control and a missed opportunity to identify and prevent the unauthorized movement and storage of this SNM. The NRC places the highest emphasis on the ability to prevent or detect the theft, loss, or diversion of SNM at the MAA boundary. In this case, the failed barriers at the MAA represented a potential diversion pathway which could have been exploited under different circumstances. The NRC concluded that the failure to conduct an adequate search of a container exiting an MAA represents a significant failure of safeguards systems, and as stated previously, resulted in two additional violations. Therefore, the three violations have been classified in the aggregate in accordance with the "General Statement of Policy and Procedures for NRC Enforcement Actions" (Enforcement Policy), NUREG-1600, as a Severity Level III problem.

In accordance with the Enforcement Policy as amended in Federal Register Notice 63 FR 71314, Policy and Procedure for Enforcement Actions; Fuel Cycle Facilities Civil Penalties and Notices of Enforcement Discretion, dated December 24, 1998, a base civil penalty in the amount of $27,500 is considered for a Severity Level III problem at a Category I fuel facility. Because your facility has not been the subject of escalated enforcement action within the last two years or two inspections, the NRC considered whether credit was warranted for Corrective Action in accordance with the civil penalty assessment process described in Section VI.B.2 of the Enforcement Policy. Your corrective actions included an immediate search of the facility to locate the material, initiation of a diversion path analysis, suspension of empty container movement for a period of time to allow a thorough understanding of the event, reemphasis of empty container searches, and initiation of a root cause analysis. To address the root causes, your staff implemented immediate and long term training enhancements for security personnel, developed and implemented a proceduralized method for Operations personnel to identify and inspect empty containers, issued flashlights to improve security guard visual searches of empty containers in low lighting conditions, and your Quality Assurance staff conducted follow up reviews to confirm the effectiveness of overall corrective actions. Additional details of your corrective actions were thoroughly discussed at the conference and are contained in your presentation material. Based on these actions, the NRC determined that corrective actions for the violations were prompt and comprehensive, and that credit was warranted for the factor of Corrective Action.

Therefore, to encourage prompt and comprehensive correction of violations, I have been authorized, after consultation with the Director, Office of Enforcement, not to propose a civil penalty in this case. However, significant violations in the future could result in a civil penalty.

Based on the information you provided at the conference, the NRC normally would not require a written response to the enclosed Notice. However, previous NRC inspections have identified procedural compliance issues at the facility in other functional areas. Because of the

procedural compliance issues associated with the failure to conduct an adequate search of a container exiting the MAA, the NRC continues to be concerned with NFS management actions to achieve consistent procedural compliance. Therefore, you are required to provide a written response to this letter and should follow the instructions specified in the enclosed Notice when preparing your response. Your response should also address the corrective actions taken to assure NFS management and the NRC that procedural compliance in all functional areas at the facility is clearly communicated, understood, and implemented by all supervisory and staff personnel. The NRC will use your response, in part, to determine whether further enforcement action is necessary to ensure compliance with regulatory requirements.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be placed in the Public Document Room (PDR). To the extent possible, your response should not include any personal privacy, proprietary, classified, or safeguards information so that it can be placed in the PDR without redaction.

If you have any questions regarding this letter, please contact Douglas M. Collins, Director, Division of Nuclear Materials Safety, at (404) 562-4700.

Sincerely,

Original signed by L. A. Reyes

Luis A. Reyes
Regional Administrator

Docket No. 70-143
License No. SNM-124

Enclosures: 1. Notice of Violation
2. Conference Attendees
3. NRC Presentation Material

cc w/encls: see page 4

NOTICE OF VIOLATION

Nuclear Fuel Services, Inc.
Erwin, TN

Docket No. 70-143
License No. SNM-124
EA No. 99-218

During an NRC inspection conducted on January 3 through February 13, 1999, violations of NRC requirements were identified. In accordance with the "General Statement of Policy and Procedures for NRC Enforcement Actions" (Enforcement Policy), NUREG-1600, the violations are listed below:

A. License Condition SG-6.1 requires the licensee to follow the measures described in the current version of the physical protection plan.

Chapter 21 of the Physical Safeguards Plan requires that non-contaminated wastes and trash being removed from Material Access Areas be searched by two guards working as a team at the removal portal using appropriate hand-held detection equipment for concealed Strategic Special Nuclear Material and for metal which could be used to shield Special Nuclear Material.

Paragraph 7.3 of Security Procedure #24, Procedure for Handling Removal of Equipment or Items from a Material Access Area to the Protected Area, which implements Chapter 21 of the Physical Safeguards Plan, requires metallic items with no concealed cavities to be searched by a watchteam. The search shall be conducted visually of the interior and exterior of drums and empty metal objects, as well as by separate and independent detector searches for unshielded special nuclear material.

Contrary to the above, between September 4, 1998 and January 11, 1999, the licensee failed to conduct or to conduct adequately two independent visual and detector searches of a 55-gallon drum, which was moved from the Building 233 Material Access Area vault. This resulted in the failure to identify the presence of seven grams of Uranium-235
(U-235) contained in a two-liter bottle inside the 55-gallon drum prior to its transfer to a Building 306 storage area. (01013)

B. License Condition S-1 requires the use of licensed material in accordance with the statements, representations, and conditions of the License Application and supplements.

License Application Section 2.7 states, in part, that "SNM operation and safety function activities are conducted in accordance with written procedures."

Licensee procedure NFS-HS-CL-10, Revision 6, "Nuclear Criticality Safety for Building 302/303/306," Section 7.0 requires, in part, that "No SNM-bearing containers may be placed or stored at a location or area unless that specific location or area is approved for SNM storage or processing by a posted station limit card."

Contrary to the above, on January 11, 1999, a 55-gallon drum containing seven grams of U-235 was stored in Building 306 East which was not approved for SNM storage by a

Enclosure 1

posted station limit card. The specific duration of the storage of the material at the unauthorized location was indeterminate. (01023)

C. 10 CFR 74.51(a)(4) requires material control and accounting systems to achieve the objective of ongoing confirmation of the presence of Strategic Special Nuclear Material (SSNM) in assigned locations.

License Condition SG-5.1 requires, in part, that the licensee follow Section 4, Revision 5, "QA and Accounting," of its Fundamental Nuclear Material Control (FNMC) Plan.

10 CFR 74.59(b)(2) requires provision for the adequate review, approval, and use of those material control and accounting procedures that are identified in the approved Fundamental Nuclear Material Control (FNMC) plan as being critical to the effectiveness of the described system.

Table 4.1.2-1 in Section 4.1 of the approved FNMC plan specifies procedure SOP-326, Rev. 19, "Procedure for SNM Material Control - High Enriched Recovery Facility," as a critical procedure within the meaning of 10 CFR 74.59(b)(2).

Section 5.0, "SNM Material Control in 233 Vault," of procedure SOP-326 requires that all SNM movements into or out of the vault be under the direction or supervision of the production foreman or a designated custodian, and all relocation transactions must be completed and documented by using the NuMAC network transfer transaction.

Contrary to the above, at some time between September 4, 1998 and January 11, 1999, a container of seven grams of SSNM having identification number 002670610 was unknowingly moved from the Building 233 vault to a Building 306 storage area without the relocation transaction being completed and documented by using the NuMAC network transfer transaction which degraded the ability to achieve the objective of ongoing confirmation of the presence of SSNM in assigned locations. (01033)

These violations represent a Severity Level III problem. (Supplement III)

Pursuant to the provisions of 10 CFR 2.201, Nuclear Fuel Services, Inc. is required to submit a written statement of explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555 with a copy to the Regional Administrator, Region II, and a copy to the NRC Resident Inspector at the facility that is the subject of this Notice, within 30 days from the date of the letter transmitting this Notice of Violation (Notice). This reply should be clearly marked as a "Reply to a Notice of Violation" and should include for each violation: (1) the reason for the violation, or, if contested, the basis for disputing the violation, (2) the corrective steps that have been taken and the results achieved, (3) the corrective steps that will be taken to avoid further violations, and (4) the date when full compliance will be achieved. Your response may reference or include previous docketed correspondence, if the correspondence adequately addresses the required response. If an adequate reply is not received within the time specified in this Notice, an order or a Demand for Information may be issued as to why the license should not be modified, suspended, or revoked, or why such other action as may be proper should not be taken. Where good cause is shown, consideration will be given to extending the response time.

If you contest this enforcement action, you should also provide a copy of your response, with the basis for your denial, to the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001.

Because your response will be placed in the NRC Public Document Room (PDR), to the extent possible, it should not include any personal privacy, proprietary, classified, or safeguards information so that it can be placed in the PDR without redaction. If personal privacy or classified information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will creates an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.790(b) to support a request for withholding confidential commercial or financial information). If safeguards information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21.

In accordance with 10 CFR 19.11, you may be required to post this Notice within two working days.

Dated this 19th day of October 1999

CONTENTS

ENFORCEMENT ACTIONS: SIGNIFICANT ACTIONS RESOLVED MATERIAL LICENSEES

July - December 1999

INTRODUCTION

This issue and Part of NUREG-0940 is being published to inform Nuclear Regulatory Commission (NRC) Material licensees about significant enforcement actions and their resolution for the second half of 1999. Enforcement actions are issued in accordance with the NRC's Enforcement Policy, published as NUREG-1600, "General Statement of Policy and Procedure for NRC Enforcement Actions." Enforcement actions are issued by the Deputy Executive Director for Regulatory Effectiveness (DEDE), and the Regional Administrators. The Director, Office of Enforcement, may act for the DEDS in the absence of the DEDS or as directed. The NRC defines significant enforcement actions or escalated enforcement actions as civil penalties, orders, and Notices of Violation for violations categorized at Severity Level I, II, and III (where violations are categorized on a scale of I to IV, with I being the most significant).

The purpose of the NRC Enforcement Program is to support the agency's safety mission in protecting the public and the environment. Consistent with that purpose, the NRC makes this NUREG available to all materials licensees in the interest of avoiding similar significant noncompliance issues. Therefore, it is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by NRC.

A brief summary of each significant enforcement action that has been resolved in the second half of 1999 can be found in the section of this report entitled "Summaries." Each summary provides the enforcement action (EA) number to identify the case for reference purposes. The supplement number refers to the activity area in which the violations are classified in accordance with the Enforcement Policy.

Supplement I	- Reactor Operations
Supplement II	- Facility Construction
Supplement III	- Safeguards
Supplement IV	- Health Physics
Supplement V	- Transportation
Supplement VI	- Fuel Cycle and Materials Operations
Supplement VII	- Miscellaneous Matters
Supplement VIII	- Emergency Preparedness

Section A of this report consists of copies of completed civil penalty or Order actions involving materials licensees, arranged alphabetically. Section B includes copies of Notices of Violation that were issued to materials licensees for a Severity Level I, II, or III violation, but for which no civil penalties were assessed.

The NRC publishes significant enforcement actions taken against individuals and involving reactor licensees as Parts I and II of NUREG-0940, respectively.

REPORT TO CONGRESS

ON

ABNORMAL OCCURRENCES

FISCAL YEAR 2002

Date Published:

April 2003

Office of Nuclear Regulatory Research
United States Nuclear Regulatory Commission
Washington, DC 20555-0001

Further, the licensee investigation concluded that the likelihood that the rods remain in the Unit 1 spent fuel pool or are at the Vallecitos facility was low, and that the low-level radioactive waste facility in Barnwell had the most significant opportunity to receive the rods.

In the NRC inspection report issued on February 27, 2002, the NRC concurred with the licensee's conclusion that the low level radioactive waste facility at Barnwell had the most significant opportunity to receive the rods, with an opportunity also existing to some small degree for the inadvertent shipment of the fuel rods to Hanford. The NRC team also concluded that, while it is highly unlikely the rods in their entirety remain in the Millstone Unit 1 spent fuel pool, it is possible that fuel pellets or fragments remain on the spent fuel pool floor as a result of the cutting methods used to process waste hardware. A layer of sediment exists over portions of the spent fuel pool floor. Inspection methods were sufficient to assure intact fuel rods or large segments would not be in the sediment. The NRC inspection team did not concur with the licensee that the Vallecitos facility was a potential location for the fuel rods, and determined that the Vallecitos facility was not a plausible location.

As a result of the inspection findings, on June 2, 2002, the NRC issued a Notice of Violation and Proposed Imposition of Civil Penalty in the amount of $288,000 to Dominion Nuclear Connecticut, Inc. (now the plant operator) because of the unprecedented loss of the fuel rods and to further emphasize the importance of adequate accounting of spent fuel at nuclear power plants.

This event is closed for the purpose of this report.

****

FUEL CYCLE FACILTIES

4. Accountability Failure at Nuclear Fuel Services in Erwin, Tennessee

The following event did not meet the AO reporting criteria since it was not determined to be significant from the standpoint of public health or safety.

In June 2001, there were several failures to follow procedures at Nuclear Fuels Services, Inc. (NFS) that resulted in two containers of strategic special nuclear material (SSNM) not being recorded in the licensee's computerized inventory of material. These two containers remained at the site, inside protected secure storage at all times, but their location was not tracked in the licensee's records system.

On June 22, 2001, two containers of SSNM were sealed with tamper-indicating devices (TIDs) and moved from one location to another inside of a secured material access area without the appropriate computer transactions being performed that track and account for the SSNM. Shortly thereafter, the licensee's material control and accounting (MC&A) program identified that two TIDs were not with other unused TIDs and computer records did not show that they had been used to seal SSNM-bearing containers. The licensee searched for the TIDs and, when they could not be found, concluded that they had been lost. On August 10, 2001, the licensee conducted a routine semi-annual physical inventory of the material stored on site and found two containers of SSNM in secure storage, but not listed in the inventory records. On August 23, 2001, during the process of reconciling the inventories, the licensee determined that these two

containers had been sealed with the missing TIDs and placed in secure storage without the appropriate computer records being made. The containers were originally sampled by the operator when the items were generated and the samples were sent to the analytical laboratory for measurements. When the items were found in the August 2001 inventory, they were opened, weighed, and sampled again. All measurements matched those initially made. In April 2002, this material discrepancy came to the NRC's attention, and subsequently, the NRC initiated the review of the event and continued follow-up activities with the licensee.

The failure to record the containers had also not been detected by an additional feature of the licensee's material control program, referred to as process monitoring. In process monitoring, mass balances are calculated around various process steps, comparing the amount of material put into a process with the amount removed from the process. As a result of errors in records of both input to and output from a process, the process monitoring system did not detect the failure to record in the computer that the material had been placed in the containers.

The consequence of the errors in the material control program was that there was no record that the material had been removed from the process area and placed in the storage area. The licensee apparently failed to meet several regulatory requirements for accounting for SSNM.

One cause of the event was the failure of licensee personnel to follow procedures. Another cause was failure by the licensee to adequately investigate indications of the problem at the time it occurred. The licensee initiated and completed an investigation to identify root and contributing causes to ensure appropriate corrective actions to prevent recurrence, as described in the next section.

The licensee's corrective actions have included: (1) providing MC&A supervisory oversight on all operating shifts, (2) reconciling MC&A discrepancies on a more frequent basis, (3) retraining responsible individuals, and (4) upgrading the licensee's investigative procedures for missing TIDs. As a result of the licensee's root cause investigation, completed in November 2002, additional corrective actions to prevent reoccurrence were identified and are being implemented. These include enhancements to the computerized MC&A systems, improved procedural compliance, and revision of their system of checks and balances to prevent such discrepancies in the future and to promptly identify any if they occur.

In April 2002, the NRC became aware of the potential occurrence of a problem associated with the MC&A program regarding identification and location of containers. The NRC requested the licensee to review the potential occurrence. As a result of correspondence with the licensee, the NRC determined in July 2002 that there had been an actual event, and it was potentially significant enough to warrant special inspection.

During August 26-27, 2002, the NRC conducted an inspection of the circumstances involved and the corrective actions taken after initial discovery. Several apparent violations of regulatory requirements were identified. The NRC held a management meeting with NFS on October 3, 2002, to further discuss the issues, their root causes, and planned corrective actions. The NRC issued a Confirmatory Action Letter (CAL) to NFS on October 15, 2002, to document specific commitments to corrective actions discussed by NFS in the meeting. NFS responded in writing to certain elements of this CAL on October 29, 2002, and provided additional information and a MC&A performance enhancement program at the management meeting with the NRC at the

Region II Office on November 21, 2002. The NRC is continuing its review of licensee actions and is planning inspections to further review the licensee's MC&A systems and procedural compliance. The NRC is also evaluating its own procedures for performing oversight of licensees' MC&A programs to determine whether changes might be needed so that such issues are identified by the NRC more promptly. Enforcement actions are under review.

This event is closed for the purpose of this report.

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OTHER NRC LICENSEES

5. Overexposure to the Extremities of Two Nuclear Pharmacists at the Bristol-Myers Squibb Radiopharmaceuticals, Inc., Facility in Rio Piedras, Puerto Rico

The following event did not meet the AO reporting criteria since it was not determined to be significant from the standpoint of public health or safety.

On April 12, 2002, Bristol-Myers Squibb Radiopharmaceuticals, Inc. reported that, as a result of an investigation of high extremity dosimeter readings and in response to NRC's IN 2000-10, "Recent Events Resulting in Extremity Exposures Exceeding Regulatory Limits," they conducted a study, which revealed that the dose an individual's fingertips could be a factor of 3 to 7 times the dose recorded on ring badge dosimetry used to measure the dose to the hands. Based on recorded annual extremity doses of 0.27 Sv (27 rem) and 0.34 Sv (34 rem) to two operators, the licensee believed that the doses to its employees' fingertips for calender year 2002 exceeded the regulatory limit of 0.50 Sv (50 rem). Based on the actual radiation dose received, the NRC concluded that it is unlikely that the radiation dose received by the operators resulted in any significant health effects. The licensee reported that corrective actions included the conduct of additional audits of the program and comprehensive improvements in the handling techniques. The licensee's failure to limit the annual dose to the extremity of two employees to 0.50 Sv (50 rem) shallow dose equivalent exposures and failure to perform adequate surveys to evaluate the exposures to the fingertips to the two employees were identified as violations as required by 10 CFR 20.1201(a)(2)(ii) and 1501, respectively. On August 22, 2002, the NRC issued a Notice of Violation for the two violations which were categorized collectively as a Severity Level II problem because the exposures were greater than two times the regulatory limit. In accordance with the NRC's Enforcement Policy, a civil penalty was not proposed because the licensee took proactive, aggressive corrective actions that led to the identification of the overexposures and changes to licensee handling procedures that significantly reduced subsequent extremity exposures.

This event is closed for the purpose of this report.

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COMMENTS OF CHAIRMAN MESERVE ON SECY-03-0036

I approve the proposed Abnormal Occurrences report to Congress, subject to the edits recommended by Cmr. Diaz. However, I do not concur with the recommendation that events 02-2 and 02-3 should be deleted from the list of Abnormal Occurrences (AOs).

As stated at the beginning of SECY-03-0036, the statute requiring that the NRC report AOs to Congress defines an AO simply as "an unscheduled incident or event which the Commission determines is significant from the standpoint of public health or safety." 42 U.S.C. § 5848. If this were the only requirement on which to base an evaluation, I would agree that neither event would likely be considered as an AO. However, as noted in the preface to the AO Report (p. xi), the Commission published a policy statement containing the much more specific criteria for determination of an AO that are included in Appendix A of the report. 62 *Fed. Reg.* 18,820 (1997). On the basis of the specific criteria cited by the staff – criterion I.C.3 for the loss of the Millstone spent fuel rods and criterion I.C.4 for the accountability failure at NFS – the staff's decision to include these events as AOs appears to me to be appropriate.

I believe that the Commission's published policy should govern the selection of events to be reported as AOs until and unless that policy is amended. Consequently, I recommend that events 02-2 and 02-3 be reported as AOs, and that the Commission consider separately the matter of revising the policy statement dealing with AO selection criteria.

VR-SECY-03-0036
DRAFT & VOTING Record
ML030870474
2003-03-27

Fuel Cycle Facilities
(Other Than Nuclear Power Plants)

Using the criteria and guidelines in Appendix A to this report, the following event, that occurred at a U.S. fuel cycle facility during this reporting period was significant enough to be reported as an AO:

02-3 Accountability Failure at Nuclear Fuel Services in Erwin, Tennessee

Appendix A (see Criterion I.C.4, "Theft, Diversion, or Loss of Licensed Material, or Sabotage or Security Breach") to this report states that any substantial breakdown of physical security or material control (i.e., access control containment or accountability systems) that significantly weakened the protection against theft, diversion, or sabotage will be considered for reporting as an AO.

Date and Place — June 21, 2001, through August 23, 2001; Nuclear Fuels Services, Inc., Erwin, Tennessee

Nature and Probable Consequences — In June 2001, there were several failures to follow procedures at Nuclear Fuels Services, Inc. (NFS) that resulted in two containers of strategic special nuclear material (SSNM) not being recorded in the licensee's computerized inventory of material. These two containers remained at the site, inside secure storage at all times, but their location was not tracked in the licensee's records system. ~~The material remained protected at all times by the licensee's physical security system.~~

On June 22, 2001, two containers of SSNM were sealed with tamper-indicating devices (TIDs) and moved from one location to another inside of a secured material access area without the appropriate computer transactions being performed that track and account for the SSNM. Shortly thereafter, the licensee's material control and accounting (MC&A) program identified that two TIDs were not with other unused TIDs and computer records did not show that they had been used to seal SSNM-bearing containers. The licensee searched for the TIDs and, when they could not be found, concluded that they had been lost. On August 10, 2001, the licensee conducted a routine semi-annual physical inventory of the material stored on site and found two containers of SSNM in secure storage, but not listed in the inventory records. On August 23, 2001, during the process of reconciling the inventories, the licensee determined that these two containers had been sealed with the missing TIDs and placed in secure storage without the appropriate computer records being made. The containers were originally sampled by the operator when the items were generated and the samples were sent to the analytical laboratory for measurements. When the items were found in the August 2001 inventory, they were opened, weighed and sampled again. All measurements matched those initially made. In April 2002, this material discrepancy came to the NRC's attention, and subsequently, the NRC initiated the review of the event and continued follow-up activities with the licensee.

The failure to record the containers had also not been detected by an additional feature of the licensee's material control program, referred to as process monitoring. In process monitoring, mass balances are calculated around various process steps, comparing the amount of material put into a process with the amount removed from the process. As a result of errors in records of

Commissioner McGaffigan's Comments on COMSECY-03-0036

I approve the proposed Abnormal Occurrence report contained in SECY-03-0036 subject to the edits of Commissioner Diaz. I completely agree with Commissioner Diaz that the report should be revised to remove two of the events from the list of Abnormal Occurrences. The Energy Reorganization Act defines an Abnormal Occurrence as an "...event which the Commission determines is significant from the standpoint of public health or safety." As pointed out by Commissioner Diaz, in the case of item 02-2 and 02-3, the staff has determined that these events were not significant from the standpoint of public health or safety. They are more appropriately listed in Appendix C.

EMcG

Commissioner Diaz's Comments on SECY-03-0036

Approved, subject to moving item 02-2, "Unaccounted for Fuel Pins at Millstone Unit One in Waterford, Connecticut" and item 02-3, "Accountability Failure at Nuclear Fuel Services in Erwin, Tennessee" from the AO section to Appendix C "Other Events of Interest." While I agree that these events meet the criteria for "consideration for reporting as AOs," as defined in Appendix A of the paper, they did *not* have any adverse affect on public health or safety for the following reasons. The staff concluded that "the current risk to human health from the unaccounted for fuel rods appears to be insignificant." The staff also indicated that the material at Nuclear Fuel Services remained at the site, inside secure storage at all times. Corresponding changes should also be made to the correspondence.

Attached are edits to the report.

Excerpted from the book, **Nukespeak:** Nuclear Language, Visions and Mindset, 1982, Stephen Hilgartner, Richard C. Bell, and Rory O'Connor, (Chapter 15, No Evidence, pages 169, 170, 171,172). According to Wikipedia, this book is a concise history of nuclear weapons and nuclear power in the United States, with special emphasis on the language of the "nuclear mindset."

Chapter 15, No Evidence

"The nuclear safeguards system of the 1960's and 1970's failed to keep track of special nuclear material accurately. Thousands of pounds of plutonium and high enriched uranium turned up missing and were designated *material unaccounted for* (MUF). Despite strong circumstantial evidence that some of this material may have been stolen, nuclear developers have repeatedly claimed that there is *no evidence* of theft.

The case of Nuclear Fuel Services Corporation fuel fabrication plant in Erwin, Tennessee illustrates the uncertainty surrounding MUF. In September 1979, the NRC received a report from the Erwin plant saying that the facility had lost track of more than 9 kilograms (about 20 pounds) of highly enriched uranium, enough to construct at least one atomic bomb. The exact amount of uranium missing was kept secret.

The plant's operating license stated that a loss of more than 9 kilograms of uranium required an immediate shutdown for a complete inventory review. Shortly after receiving the report, the NRC ordered the plant, which produces fuel for the Navy's nuclear submarines, temporarily shut down. This incident was only the most recent in a series of *inventory differences* at Erwin. Over the past decade, losses there exceeded 246 pounds.

What happened to Erwin's missing material? There are a number of possible explanations for the inventory differences. SNM could have been trapped in the plant's *process stream* – for example, caught in pipes or tanks. It could have been lost in the plant's *waste stream*, disappearing into the air or into scrap and waste water. Missing SMN might never have existed: it could simply be the result of *prior miscalculation*. It could have been explained by *random measurement errors of systematic bias* in measurement devices. Or it could have been stolen. The purpose of the shutdown and re-inventory at Erwin was to determine which of these explanations was correct.

Determining whether an inventory difference is due to statistical noise in the measurement process or to theft or diversion is a difficult business. As William J. Dircks, head of the NRC's Office of Nuclear Material Safety and Security, told the journal *Science*: "We're not counting discreet items; we're really estimating the amount of uranium atoms that may be within the system at any one time.

The NRC establishes *MUF thresholds*, or *alarm levels*, for each plant under its jurisdiction. (This includes commercial plants, but does not include federal installations, like Hanford, which are operated by the DOE and where reprocessing has been carried out since the Manhattan Project.) If the inventory difference exceeds the threshold – as it did in the case of Erwin – then an inventory review is conducted. But some critics charge

that the re-inventory process is nothing more than an elaborate charade. Thomas B. Cochran, a nuclear physicist with the Natural Resources Defense Council, a nonprofit environmental group, wrote in 1978:

> "Under the NRC practices, the MUF game is played as follows: When the MUF exceeds (the alarm level) the facility is shut down. A big review is launched. Several possible *loss mechanisms* are "*discovered*" or "*postulated*", and then casting all logic aside in one mystical leap, the NRC staff concluded the MUF is due to one or more of these loss mechanisms and there is "*no evidence* of diversion." Through this mechanism the MUF is "*explained*," i.e. reduced to less than (the alarm level) and the facility is allowed to reopen."

In the Erwin plant, however, the investigators were unable to develop a *plausible technical explanation* for the inventory difference, *satisfactory loss mechanisms* were not *identified.* Dircks recommended that the NRC revoke the Erwin plant's license. But in January 1980, in a closed meeting, the commission voted to allow Erwin to reopen, easing the plant's *accountability requirements* by raising the *alarm threshold* to a level the plant could meet. Since the plant could not meet the conditions of its license, the NRC simply relaxed the rules to make them "*more realistic.*"

The DOE had sent the NRC commissioners a classified letter saying that the continued operation of the Erwin plant was essential to *national security* apparently convincing the NRC to amend Erwin's license. (In October 1980 after the plant had reopened with its new *relaxed license*, the NRC staff discovered new *loss mechanisms*, reducing the amount of MUF by more than half).

In February 1980, the Natural Resources Defense Council (NRDC) requested that a hearing be held on Erwin's license, and in July 1980, the NRC voted 3 to 2 to change its rules for holding adjudicatory hearings so that it would not have to comply with the NRDC's petition. The majority doubted whether the "*public interest*" would be served by holding a hearing since the case involved "*sensitive issues*" and "basic regulatory policy questions regarding the conduct of military functions." One of the dissenting commissioners called the decision "dishonorable and disgraceful" charging that "the only thing being protected against here is the potential embarrassment to this agency [the NRC] or to the Department of Energy that might flow from effective probing of particular facts in this case."

(**NOTE**: This DOE influence on and pressure of the NRC appears to continue today).

Throughout the Erwin controversy, the NRC repeatedly claimed that there was "*no evidence*" that the missing uranium had been stolen. The repeated use of the phrase *no evidence*, a classic defense of the nuclear mindset, provoked NRC Commissioner Peter Bradford, who pointed out that the phrase "has historically been used in situations where normal English would have settled for a phrase more like 'no absolute proof.'" Bradford

cited the case of the Nuclear Materials and Equipment Corporation (NUMEC) in Apollo, Pennsylvania, to illustrate the importance of this linguistic distinction.

NUMEC produces highly enriched uranium fuel for the Navy's nuclear reactors and manufacturers plutonium fuel rod elements for the *Fast Flux Test Facility* (*FFTF*), an experimental breeder reactor at Hanford, Washington. Since the early 1960's, NUMEC has had a history of *inventory discrepancies* and security violations. As early as 1962, an AEC report noted that "numerous deficiencies were found in NUMEC's overall security program." That report, however, was not made public until 1977.

While there have been literally hundreds of violations at the NUMEC plant, the most serious one was the discovery in 1965 that the facility had lost track of 381.6 pounds of highly enriched uranium. After inventory review, government officials decided that about half of the MUF had been lost through "*known mechanisms*." The remainder was still unaccounted for.

Over the years, the nuclear agencies have publicly insisted that there is *no evidence* that the NUMEC MUF was stolen. But in secret documents and internal discussions, the government has shown less certainty about what actually happened. A secret memo to AEC Chairman Glenn Seaborg, written in 1967 and declassified in 1977, concluded that "it cannot be said unequivocally that theft or diversion has not taken place, but the *most probable explanation* is that NUMEC consistently underestimated its plant process losses....." Other secret documents, declassified at the same time, indicate that the AEC and CIA suspected that China might have stolen the NUMEC uranium because atmospheric debris from the first Chinese bomb test resembled the missing NUMEC uranium. After the AEC concluded that China had developed its own source of weapons-grade uranium, this theory was discarded. But suspicion that the uranium was stolen did not disappear.

In November 1977, the government declassified two documents written in 1976 which showed that the nation's intelligence agencies suspected that Israel diverted the NUMEC uranium. The documents, which were released under a Freedom of Information Act suit, indicated the FBI, the CIA, and the National Security Council all shared this view. No other country was named as the possible recipient of the material. Nevertheless, before Congress and the media, ERDA and the NRC continued to claim that there was "*no evidence*" of diversion at NUMEC.

As NRC Commissioner Peter Bradford pointed out in 1980, the "*no evidence*" position that the two agencies presented really described "a situation in which there was considerable circumstantial evidence, but no conclusive proof. When challenged, the defenders of this practice had tended to assert that evidence is synonymous with proof."

By the summer of 1979, the NRC had stopped asserting that there was no evidence of a diversion at NUMEC. NRC Chairman Joseph Hendrie presented testimony before Congress in which he said that circumstantial evidence "points in one way, but not enough to go out and indict someone." His testimony was accompanied by a report

which said that security at the NUMEC facility was so lax that "a knowledgeable insider could quite easily have obtained material in that plant."

Commercial facilities like Erwin and NUMEC are not the only ones with MUF problems. The reprocessing plant at the Department of Energy's Savannah River Plant, a 300-square mile nuclear complex which produces plutonium and tritium for nuclear weapons, had a *net shortage* of 145.5 kilograms of plutonium as of 1978. In a report released in early 1980, the General Accounting Office criticized the DOE for concluding that there was no evidence that any of that MUF was diverted. According to the GAO report: "The Department of Energy assumes that none of this was diverted. It attributes the shortage of inaccurate production estimates, process measurements, shipper/receiver measurements, and accounting and normal operating losses. GAO believes that with existing material control and accountability technology, the Department has no valid basis for this assumption and is thus unable to provide definitive assurance that no plutonium has been diverted."

NOTE: See attached NFS SNM-124 License Amendments 1-85, as of January 27, 2009. Amendments 3, 7, 16, 21, 35, 41, 42, 44, 46, 53, 55, 57, 71, 74 all involved time extensions, modifications or exemptions for SNM inventory. Amendment 74 involved "Authorize Use of Shipper's Quantities to Revolve Shipper-Receiver Difference."

-end-

(A product of the Erwin Citizens Awareness Network, P. O. Box 1151, Erwin, TN 37650, June 2009)

[redacted]

SPECIAL NUCLEAR MATERIAL LICENSE
SNM-124
CHAPTER 9

Table 9.1
License History

SNM-124 was most recently renewed by the NRC on July 2, 1999. The following amendments have been issued subsequent to that renewal.

Amendment Number	Subject	Effective Date
1	Authorization to Operate KAST Fuel Process Areas 100-900, A-C, and Auxiliary Systems	08/03/1999
2	Authorization to Allow Use of QC Vault and to Delete License Conditions S-6 and S-7	02/04/2000
3	Authorization to Delay Conducting Physical Inventory Pursuant to 10 CFR 70.34	04/03/2000
4	Authorization to Delete License Condition S-13	04/03/2000
5	Authorization to Operate KAST Uranium Recovery Areas D-J	05/05/2000
6	Revisions to the Fundamental Nuclear Material Control Plan	05/16/2000
7	Authorization to Delay Conducting Physical Inventory Pursuant to 10 CFR 70.34	06/02/2000
8	Clarification of Possession Limits for Pu Residual Contamination, Special Air Sampling, and Internal Exposure Assessments	06/13/2000
9	Bulk Chemical Storage Tanks Analysis	07/03/2000
10	Authorization to Adjust Annual Limit on Intake (ALI) and Derived Air Concentration (DAC)	08/11/2000
11	Addition of Industrial Park Facility	09/13/2000
12	Authorization to Adjust Liquid Effluent Discharge Limits and NRC Correction of Previous Amendments	10/27/2000
13	Revision to Fundamental Nuclear Material Control Plan and Change to Safeguard Condition SG-4.16	11/30/2000
14	Revision of License Conditions S-39 and S-41	12/13/2000
15	Approval of NFS Site Security Training Plan, Revision 15, Safeguards Contingency Response Plan, Revision 0, and Emergency Plan, Revision 4	12/22/2000
16	Approval of Request for Time Extension to Conduct a Physical Inventory	01/15/2001
17	Revision of License Condition SG-6.1	01/30/2001
18	Revision of License Condition S-28	01/30/2001

Amendment Number	Subject	Effective Date
19	Revision of License Condition S-25	02/28/2001
20	Amendment to License Condition S-1	03/01/2001
21	Approval of Request for Time Extension to Submit the Physical Inventory Summary Report	03/26/2001
22	Deletion of License Conditions S-43 and S-44	03/26/2001
23	Authorization to Amend License Condition S-41 for Extension of Compensatory Measures from April 30, 2001 to June 30, 2001	04/24/2001
24	Deletion of License Condition S-20 and Review of 04/27/2001 Revised Safety Demonstration (S-27)	04/27/2001
25	Amend License Conditions for Safety Related Equipment	06/04/2001
26	Revision of License Condition S-22	06/04/2001
27	Approval of North Site Decommissioning Plan	06/19/2001
28	Revisions to HEU FNMC Plan, License Condition SG-5.1	06/27/2001
29	Authorization to Extend Safety Condition S-41 to July 31, 2001	06/29/2001
30	Authorization to Extend Deadline for Safety Conditions S-28, S-29, S-31, S-32, S-33, S-34, S-36, and S-37 to November 1, 2001	07/18/2001
31	Approval of ISA Plan and Deletion of License Conditions S-28 through S-38	10/30/2001
32	Deletion of License Conditions S-41 and S-45	02/22/2002
33	Revisions to HEU FNMC Plan, License Condition SG-5.1	03/29/2002
34	Approval of Emergency Plan, Revision 5	05/03/2002
35	Time Extension to Submit the Physical Inventory Summary Report	07/19/2002
36	Revised Fundamental Nuclear Material Control Plan	08/30/2002
37	Revised Appendix A to Chapter 5 of North Site Decommissioning Plan	03/31/2003
38	Authorization to Reduce Source Term at the Site Through Soil Removal	05/07/2003
39	Authorize Use of UNB and Increased Possession Limit	07/07/2003
40	Authorize Use of ICRP 68 Values	08/21/2003
41	Approve Time Extension to Perform Receipt Measurements	08/29/2003
42	Approve Time Extension to perform Receipt Measurements	09/15/2003
43	Approve Revision 4 to NFS Physical Protection Plan	10/10/2003
44	Approve Time Extension to Perform Independent Assessment of MC&A Program	10/24/2003

[redacted]

SPECIAL NUCLEAR MATERIAL LICENSE
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Amendment Number	Subject	Effective Date
45	Approve Exemption from Decommissioning Financial Assurance Requirements for Specific Equipment	11/13/2003
46	Approve Time Extension to Perform Receipt Measurements	12/31/2003
47	Authorize Use of BLEU Prep. Facility	01/13/2004
48	Approve Revisions to FNMC Plan	02/19/2004
49	Approve Organizational Changes to Chapter 2	03/13/2004
50	Approve Revisions to HEU FNMC Plan	05/25/2004
51	Approve Operation of the BLEU OCB/EPB	07/30/2004
52	Remove Sampling Requirements for Banner Spring Branch	09/13/2004
53	Approve Time Extension to Perform Receipt Measurements	10/15/2004
54	Administrative Change – Revision of Physical Protection Plan, Safeguards Contingency Plan, and T&Q Plan	10/29/2004
55	Approve Modification of Certain Material Inventory Measurements	11/05/2004
56	Approve Revision to FNMC Plan	12/08/2004
57	Approve Time Extension to Perform Receipt Measurements	01/10/2005
58	Approve Administrative Changes to Air Sampling and Bioasssay Programs	01/13/2005
59	Approve Deletion of License Conditions S-2, S-4, and S-5	01/28/2005
60	Approve Updated Schedule for North Site Decommissioning	02/29/2005
61	Approve Revised Date for Annual Update of Safety Demonstration Section	06/17/2005
62	Approve Possession Limit Increase	06/28/2005
63	Approve Revision 1 of the Physical Protection Plan	08/11/2005
64	Approve Changes to Certain Administrative Programs	08/24/2005
65	Approve Revisions to FNMC Plan	11/16/2005
66	Approve Changes to the Physical Protection Plan	11/28/2005
67	Approve Changes to Procedure Reviews by SSRC	12/12/2005
68	Approve Changes to FNMC Plan, and Replacement of Table 5.1	12/21/2005
69	Approve Final Status Survey Method for Subsurface Soils	02/15/2006
70	Approve Extension of Safeguards Condition SG-4.34	04/13/2006
71	Approve One-Time Exemption From Physical Inventory Deadline	06/06/2006

[redacted]

SPECIAL NUCLEAR MATERIAL LICENSE
SNM-124
CHAPTER 9

Amendment Number	Subject	Effective Date
72	Approve Change to Required Experience of Discipline Vice-President	07/03/2006
73	Approve Exemption of Low-Level Waste Shipments From Certain Physical Security Requirements	07/17/2006
74	Authorize Use of Shipper's Quantities to Resolve Shipper-Receiver Difference	08/08/2006
75	Incorporate Changes to Chapter 3	01/05/2007
76	Approve Extension of Safeguards Condition SG-4.34	04/11/2007
77	Approve Administrative Changes to Part I of SNM-124	05/09/2007
78	Partial Approval of Changes to Physical Protection Plan for Category I, High-Enriched Uranium	10/18/2007
79	Approve Increase in Possession Limit	11/23/2007
80	Approve Changes to Physical Protection Plan for Category I, High-Enriched Uranium	04/01/2008
81	Approve Extension of Safeguards Condition SG-4.34 for Receipt Verification	04/28/2008
82	Approve Changes to Configuration Management Program	05/22/2008
83	Approve Physical Protection Plan for Special Nuclear Material of Moderate Strategic Significance	07/25/2008
84	Approve Changes to Physical Protection Plan for Category I, High-Enriched Uranium	11/10/2008
85	Consent to the Indirect Transfer of Control of License SNM-124	12/31/2008

[redacted]

Item Number: FC940839 **Last Updated:** 10/11/1995

Narrative:

AN ALERT WAS DECLARED WHEN A FIRE OCCURRED ON TOP OF BUILDING [redacted] DURING MAINTENANCE WORK ON THE ROOF. THE BUILDING CONTAINS THE [redacted].

NO RADIOACTIVE MATERIALS WERE RELEASED. NO EVACUATIONS ORDERED.

PRELIMINARY RADIATION SURVEYS INDICATE THAT NO PERSONNEL CONTAMINATION OR RADIATION RELEASES OCCURRED.

Event Date: 10/13/1993 **Discovery Date:** 10/13/1993 **Report Date:** 10/13/1993

Licensee/Reporting Party Information:

Agreement State Regulated:	NO	Reciprocity:	NONE		
License Number:	SNM-0124	Name:	NUCLEAR FUEL SERVICES, INC.		
NRC Docket Number:	07000143	City:	ERWIN		
NRC Program Code:	21210	State:	TN	Zip Code:	376509718
Responsible NRC Region:	2				

Site of Event:

Site Name	ERWIN	State:	TN

Additional Involved Party:

License Number:	NA	Name:	NA		
		City:	NA		
		State:	NA	Zip Code:	NA

Other Information:

NRC Reportable Event:	Y	Abnormal Occurrence:	N
Agreement State Reportable Event:	N	Investigation:	
Atomic Energy Act Material:	Y	Record Complete:	
Consultant Hired:	N	Event Closed:	Y

Event Cause:

FCP - FUEL CYCLE PROBLEMS

Cause: EXTERNAL FIRE OR EXPLOSION

Corrective Actions Information:

Action Number:	Corrective Action:
FCP	
1	NOT REPORTED

Reporting Requirements:

FCP

Reporting Requirement: 70.50(a) - Event that prevents immediate protective actions necessary to avoid exposures to radiation or radioactive materials that could exceed regulatory limits or releases of licensed material that could exceed regulatory limits.

Mode Reported: Written

References:

Reference Number:	Entry Date:	Retraction Date:	Coder Initials:	Reference Type:
EN26215	03/31/1994		NB	EVENT NOTIFICATION

[redacted] - Unmarked Legacy Reference

[redacted]

[redacted]

Item Number: FC960215 **Last Updated:** 03/11/1998

Narrative:

The licensee reported the declaration of a site area emergency due to a fire exceeding 15 minutes, a breech of containment, and the potential for a radioactive release at 1226. The fire was detected in the [redacted] room. It spread to the duct work on the roof and breeched the duct work. At the time of this notification, the fire was under control, and it was extinguished by 1255 (during this notification). The incinerator was burning radioactive material at the time so the potential existed for a radiological release. The licensee determined that there was a maximum of [redacted] of high enriched uranium available for release and is currently performing evaluations to determine a more accurate quantity. (It was later determined that there was approximately [redacted] enriched uranium available for possible release.) At the time of this notification, the wind was blowing out of the south (away from the local population center) at a speed of three to five miles per hour. Offsite evacuation was not recommended. The local fire department and local law enforcement representative responded to the site to assist onsite emergency response personnel. The fire in the [redacted] building was detected at 1158. The licensee declared the site area emergency at 1226, and the fire was extinguished at approximately 1230. The fire damage to the roof ventilation duct work was in an area approximately 40 feet long. The licensee notified the State of Tennessee, and the State's independent air sampling system was activated at approximately 1340. The state also dispatched four representatives to perform release assessments. The NRC dispatched a regional manager, two regional radiation specialists, and a headquarters project manager to the site. The NRC also entered the monitoring phase of normal operations at 1345. The licensee has estimated that the worst case potential release could have been up to 200 grams of uranium-235, and the licensee's analytical calculations show that there could be up to a 3 millirem exposure at a distance of 1 mile down wind. The licensee has locked down its facility and has performed nasal swipes for the responders to the fire. The results are currently pending. The licensee downgraded its emergency classification to unusual event at 1450 because the fire was extinguished and under control and because the situation does not appear to be as severe. The licensee downgraded its emergency classification to unusual event at 1450. The licensee also notified FEMA, ANI, and the State of Tennessee of this change in classification. The NRC operations center notified the R2DO (Uryc), NMSS EO (Cool), FEMA (Earl), DOE (Moore and Schmit), EPA (Checkan), HHS (Raab), USDA (Cooper), and ARAC. The NRC terminated the monitoring phase of normal operations at 1700 on April 2, 1996. A Regional Manager, two Regional Radiation Specialist, and a Headquarters Project Manager are currently onsite; and they expect to be joined by a fire protection specialist from headquarters later today. The team was also given an augmented inspection team charter today. In addition, the NRC issued a Confirmatory Action Letter this afternoon to require the Licensee to maintain the system down until the licensee finishes its investigation and meets with the NRC to discuss the results and corrective actions. The NRC plans to hold a press conference when the Augmented Inspection Team has completed its investigation. There has been media interest in this event. The cause of the fire is still under investigation. apparently, the licensee had just shut the incineration system down when the fire was identified. The fire damaged approximately 150 feet of the ventilation ducting on the roof, and the damage appeared to be mostly down stream of a blower system that is on the roof with the portion closest to the fan having the most damage. There did not appear to be any damage to the portion of the system that goes from the incinerator through a scrubber which is located inside the building, out a ventilation duct, up through the roof, and over to the blower. The latest measurements indicate that the amount of material involved was approximately 8 grams in the ventilation system and approximately 45 grams in the actual burn. The results from air samples taken during and shortly after the event and surveys for contamination onsite indicated nothing unusual, and there did not appear to be any spread of contamination from the ducting system. In addition, the results of the nasal smears, urine samples, and lung counts on the fire response personnel thus far have been negative. The direct radiation surveys on the individuals who fought the fire also showed no contamination of the individuals. The licensee currently plans to continue performing lung counts until everyone that was involved is counted. The Tennessee Radiological Health Department representative performed surveys and took samples of soil and vegetation down wind of the fire. The licensee split samples with the state so that both can run samples for comparison. The licensee has also taken samples of soil and vegetation in the areas where samples are normally taken to see if there is any indication of impact in those areas. In addition, the licensee's environmental manager has put together an augmented sampling plan which will be taking additional soil and vegetation samples and will perhaps perform some surveys in down stream locations.

Event Date: 04/02/1996 **Discovery Date:** 04/02/1996 **Report Date:** 04/02/1996

Licensee/Reporting Party Information:

Agreement State Regulated:	NO	Reciprocity:	NONE
License Number:	SNM-0124	Name:	NUCLEAR FUEL SERVICES, INC.
NRC Docket Number:	07000143	City:	ERWIN
NRC Program Code:	21210	State:	TN Zip Code: 376509718
Responsible NRC Region:	2		

Site of Event:

Site Name	ERWIN	State:	TN

Additional Involved Party:

License Number:	NA	Name:	NA
		City:	NA
		State:	NA Zip Code: NA

Other Information:

NRC Reportable Event:	Y	Abnormal Occurrence:	N
Agreement State Reportable Event:	N	Investigation:	Y
Atomic Energy Act Material:	Y	Record Complete:	
Consultant Hired:	N	Event Closed:	

Event Cause:

[redacted]

EQP - EQUIPMENT
Cause: OTHER
FCP - FUEL CYCLE PROBLEMS
Cause: OTHER
RLM - RADIOACTIVE MATERIAL REL.
Cause: OTHER

Corrective Actions Information:

Action Number:	Corrective Action:
EQP	
1	NOT REPORTED
FCP	
1	NOT REPORTED
RLM	
1	NOT REPORTED

Release of Material or Contamination Information:

Type or Release or Contamination:	Activity: Ci	Activity: GBq	Radionuclide:	Effect of Release or Contamination:
SURFACE	NR	NR	U-235	

Source of Radiation:

EQP

Source Number: 1
Source/Material: FUEL FABRICATION MATERIAL
Device Name: INCINERATOR
Manufacturer: NR
Model Number: NR
Serial Number: NR
Radionuclide or Voltage (kVp/MeV): U-235
Activity: U-235 Ci GBq
Problem with Source:

FCP

Source Number: 1
Source/Material: FUEL FABRICATION MATERIAL
Device Name: INCINERATOR
Manufacturer: NR
Model Number: NR
Serial Number: NR
Radionuclide or Voltage (kVp/MeV): U-235
Activity: U-235 Ci GBq

RLM

Source Number: 1
Source/Material: FUEL FABRICATION MATERIAL
Device Name: INCINERATOR
Manufacturer: NR
Model Number: NR
Serial Number: NR
Radionuclide or Voltage (kVp/MeV): U-235
Activity: U-235 Ci GBq

Device/Associated Equipment:

EQP

Device Number: 1
Device Name: INCINERATOR
Manufacturer: NR
Model Number: NR
Serial Number: NR
Problem with Equipment:

Device Number: 2
Device Name: DUCTWORK
Manufacturer: NR
Model Number: NR
Serial Number: NR
Problem with Equipment:

FCP

Device Number: 1
Device Name: INCINERATOR
Manufacturer: NR
Model Number: NR
Serial Number: NR

[redacted]

Device Number: 2
Device Name: DUCTWORK Model Number: NR
Manufacturer: NR Serial Number: NR

RLM
Device Number: 1
Device Name: INCINERATOR Model Number: NR
Manufacturer: NR Serial Number: NR

Device Number: 2
Device Name: DUCTWORK Model Number: NR
Manufacturer: NR Serial Number: NR

Reporting Requirements:
EQP
Reporting Requirement: 70.50(a) - Event that prevents immediate protective actions necessary to avoid exposures to radiation or radioactive materials that could exceed regulatory limits or releases of licensed material that could exceed regulatory limits.
Mode Reported: Telephone

FCP
Reporting Requirement: NRCB 91-01 - Loss of criticality safety controls.
Mode Reported: Telephone

RLM
Reporting Requirement: 70.50(b)(4) - Unplanned fire or explosion damaging any licensed material or any device, container, or equipment containing licensed material.
Mode Reported: Telephone

References:

Reference Number:	Entry Date:	Retraction Date:	Coder Initials:	Reference Type:
9604030120	04/09/1996		DRL	PRELIMINARY NOTIFICATION
[redacted] - Unmarked Legacy Reference				
9604030124	04/09/1996		DRL	PRELIMINARY NOTIFICATION
[redacted] - Unmarked Legacy Reference				
EN30220	04/09/1996		DRL	EVENT NOTIFICATION
[redacted] - Unmarked Legacy Reference				
PN296024A	04/09/1996		DRL	PRELIMINARY NOTIFICATION
[redacted] - Unmarked Legacy Reference				
PN296024B	04/09/1996		DRL	PRELIMINARY NOTIFICATION
[redacted] - Unmarked Legacy Reference				
9605280066	10/03/1996		DCH	INSPECTION REPORT
[redacted] - Unmarked Legacy Reference				
PN296026	10/03/1996		DCH	PRELIMINARY NOTIFICATION
[redacted] - Unmarked Legacy Reference				
9606070178	03/14/1997		DCH	LICENSEE REPORT
[redacted] - Unmarked Legacy Reference				
TN96020	03/14/1997		DCH	AGREEMENT STATE LETTER
[redacted] - Unmarked Legacy Reference				
9712040076	03/11/1998		DCH	LICENSEE REPORT
[redacted] - Unmarked Legacy Reference				
PN296024	03/11/1998		DRL	PRELIMINARY NOTIFICATION
[redacted] - Unmarked Legacy Reference				

Net sales

Net sales for the third quarter amounted to SEK 275.0 million (274.2) and for the period January-September, to SEK 867.8 million (964.8). Net sales increased in local currencies by 3.1 per cent in the third quarter and decreased by 15.5 per cent in the period January-September. There is growth in the three segments; Sweden, Germany and Global Services, while the other two segments report falling sales.

Profit

Operating profit for the third quarter amounted to SEK –7.8 million (–4.4) and for the period January-September to SEK –68.1 million (20.7). The Group's loss is attributable to the USA and the UK. The operating margin in the other segments was 8.9 per cent (10.2) in the third quarter and 8.0 per cent (8.4) in January-September. Foreign exchange effects had a negative impact of SEK –1.1 million (1.0) on the operating profit for the third quarter and of SEK –9.9 million (1.0) for the period January-September.

Net financial income deteriorated by SEK 6.4 million due to increased net interest-bearing debt and increased borrowing costs.

Sweden

Net sales in the third quarter were slightly lower than the previous year and amounted to SEK 34.5 million (38.4). In January-September sales increased by 5.5 per cent to SEK 115.8 million (109.8). Operating profit in the third quarter fell to SEK 3.5 million (11.5) and in January-September to SEK 9.1 million (22.0). The operating margin for January-September fell to 7.9 per cent (20.0).

The deterioration in earnings is due to a poorer product mix and an unplanned six-day production stoppage at the melting plant and longer throughput times for the large components treated in 2009. New equipment has been brought into operation and the production bottlenecks are being successively eliminated. The market and order situation continue to be good. During the quarter Studsvik signed its first order for treatment of low-level waste from Italy. The order is for 270 tonnes of organic waste from the nuclear power facility in Caorso.

United Kingdom

Net sales in the third quarter fell to SEK 18.4 million (34.2) and amounted to SEK 65.8 million (113.9) in January-September. The operating profit for the third quarter was SEK –7.3 million (0.6) and for January-September SEK –40.8 million (2.0).

Capacity utilization in the consulting operations increased after two weak quarters, but did not compensate for continued low capacity utilization in the decommissioning operations. Decommissioning projects have been focused on smaller and clearly defined contracts since the end of the first half-year. The decommissioning market contracted during the year as a consequence of the tight financial situation in the British economy. Extensive marketing initiatives are being carried out, but the order book was at a low level at the end of the third quarter.

The metallic recycling facility in Workington became operational in September, when the first volumes of commercial material were also processed.

Germany

Net sales increased in the third quarter to SEK 126.8 million (98.1). Net sales for the period January-September amounted to SEK 337.0 million (277.5), which corresponds to an increase of 7.6 per cent in local currency. The operating profit for the third quarter was SEK 9.6 million (3.1) and for January-September SEK 20.2 million (14.4). The operating margin continued to improve during the quarter, to 7.6 per cent (3.1).

The market and order situation in the German operations is good. Profitability improved in both engineering and services and decommissioning. Annual maintenance work at power-producing reactors continued at a normal rate during the third quarter. Ongoing decommissioning projects in Germany and Belgium went according to plan and at a good level of profitability.

USA

Net sales for the third quarter amounted to SEK 42.2 million (47.4) and for the period January-September, to SEK 149.6 million (272.0). The operating loss for the third quarter amounted to SEK –12.8 million (–17.3) and for the period January-September, to SEK –54.3 million (–5.2).

Another two contracts were signed for the Erwin operations. Contracts have now been signed covering 51 of the USA's 103 reactors. The volumes delivered to the facility were, however, low and some deliveries were postponed. Consequently the Erwin operations reported a continued loss. The efficiency improvements made in Memphis have resulted in more robust operations that are profitable at considerably lower volumes than before. The third quarter's inflow of material for processing was, however, low, resulting in a minor loss in the quarter. The low waste volumes, both in Erwin and Memphis, are mainly a consequence of the economic conditions.

In the USA a small consulting business has been started, focusing on Studsvik's patented THOR technology. The business is profitable and the customer base consists of both American and international customers. The interest in evaluating THOR technology for different types of waste is great.

THOR Treatment Technologies (TTT) signed an order in October for a waste treatment facility at the US Department of Energy's facilities at Savannah River. The order value is USD 55 million. The work will start in 2010 and is expected to continue for three years. TTT is a joint venture with the American URS Corporation. Studsvik has a 50 per cent share in TTT.

Global Services

Net sales rose in the third quarter to SEK 51.2 million (41.6). Net sales in January-September were SEK 177.1 million (133.6), which corresponds to an increase of 16.8 per cent in local currencies. Operating profit for the third quarter increased to SEK 5.8 million (3.6) and to SEK 21.3 million (7.6) for the period January-September. Profitability improved during the year and the operating margin for January-September was 12.0 per cent (5.7).

In materials technology demand continued to be strong for reactor fuel and materials testing associated with the ageing, overhaul and modernization of nuclear power plants around the world. Modernization, modification and new production also create heavy demand for consultants with advanced nuclear engineering skills, which resulted in stronger earnings for the consulting operations. ALARA Engineering, which was acquired in late 2008, performed well. Software for fuel optimization reported a profit that was by and large on the same level as the previous year.

After the close of the reporting period Studsvik agreed to sell its personal dosimetry operations to the American company Landauer. The sale means a capital gain of SEK 6.5 million, which will be reported in the fourth quarter.

Investments

The Group's investments in the third quarter were SEK 23.8 million (20.2) and for the period January-September, to SEK 74.6 million (60.3). Investments in the new treatment facility in the United Kingdom of SEK 8.3 million are included in the third quarter and of SEK 51.8 million in January-September.

NRC: Event Notification Report for May 5, 2000

General Information or Other	Event Number: 36970

REP ORG:	TENNESSEE DIV OF RAD HEALTH	NOTIFICATION DATE:	05/04/2000
LICENSEE:	STUDSVICK PROCESSING FACILITY, LLC	NOTIFICATION TIME:	09:45[EDT]
CITY:	ERWIN REGION: 2	EVENT DATE:	04/30/2000
COUNTY:	STATE: TN	EVENT TIME:	12:00[EDT]
LICENSE#:	R-S1001 AGREEMENT: Y	LAST UPDATE DATE:	05/04/2000
DOCKET:			

PERSON	ORGANIZATION
ROBERT HAAG	R2
JOSEPHINE PICCONE	NMSS

NRC NOTIFIED BY: DEBRA SHULTS
HQ OPS OFFICER: JOHN MacKINNON

EMERGENCY CLASS: N/A
10 CFR SECTION:
NAGR AGREEMENT STATE

5000 SQUARE FOOT AREA CONTAMINATED WITH AN ESTIMATED 0.49 MILLICURIES OF PRIMARILY COBALT-60.

On 05/01/2000, the licensee called to report a spill of residue inside their processing building. A 5000 square foot area was affected/contaminated with an estimated 0.49 millicuries of mixed fission/activation products (primary Co-60) when the event occurred on 04/30/00. Gross maslin smears revealed 30,000 dpm with a maximum small area smear of 6,600 dpm/100 square centimeter. There was no release of radioactive material to the environment. There were two minor personnel contamination incidents: one involving an individual's shoes and one involving an individual's hair. Both were easily decontaminated and released. There was no damage to equipment. Decontamination had already begun when reported. This event does not pose a risk to public health and safety but is reportable under 1200-2-5-141 (2)(c)1 i, ii, and iii. It required restricted access for greater than 24 hours, 0.49 millicuries is greater than 5 times the lowest ALI for Co-60, and access was restricted to allow isotopes with less than 24 half-lives to decay.

NRC: Event Notification Report for May 22, 2001

General Information or Other	Event Number: 38018

REP ORG:	TENNESSEE DIV OF RAD HEALTH	NOTIFICATION DATE:	05/21/2001
LICENSEE:	STUDSVICK PROCESSING FACILITY	NOTIFICATION TIME:	12:30[EDT]
CITY:	ERWIN REGION: 2	EVENT DATE:	05/18/2001
COUNTY:	STATE: TN	EVENT TIME:	16:30[EDT]
LICENSE#:	R-86011 AGREEMENT: Y	LAST UPDATE DATE:	05/21/2001
DOCKET:			

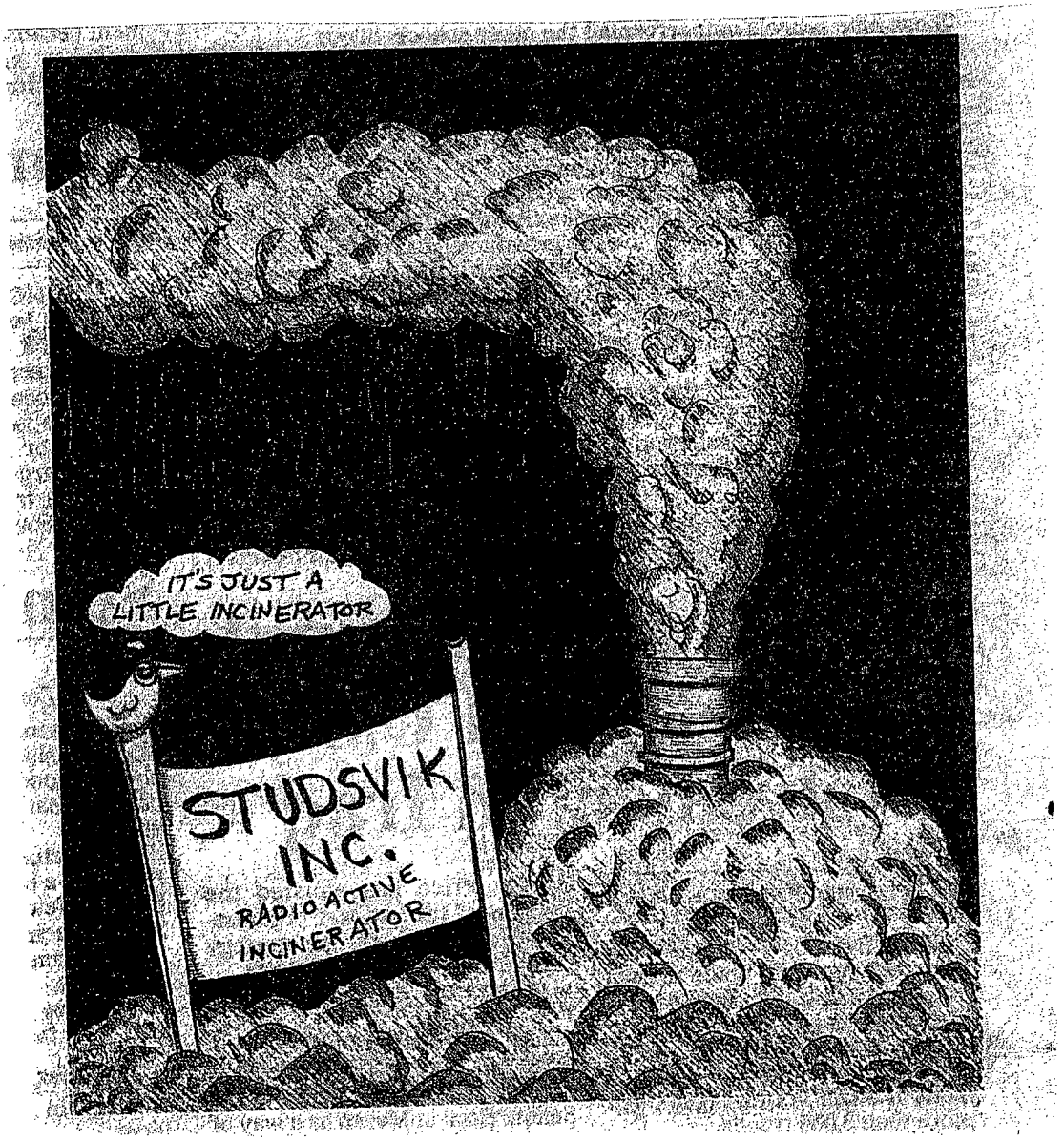
PERSON	ORGANIZATION
LEONARD WERT	R2
JOHN HIICKEY	NMSS

NRC NOTIFIED BY: FREEMAN/SHULTS(by fax)
HQ OPS OFFICER: CHAUNCEY GOULD

EMERGENCY CLASS: N/A
10 CFR SECTION:
NAGR AGREEMENT STATE

This licensee is authorized for the receipt, possession, processing, storage, handling and shipment of radioactive waste resins. During routine operations at the facility, a spill of approximately four cubic feet occurred from one of the process vessels. The vessel was shut down and the facility evacuated. It is estimated that 29 millicuries of activation and mixed fission products were released during the spill. The material was released into a controlled area. There were no environmental releases. Negative pressure was maintained during the event. The HVAC system was shut down after the release as was the thermal system to the process vessel. During the investigation, five individuals were slightly contaminated as confirmed by nasal swipes. Invivo counting of these individuals will be conducted on Wednesday, May 23 at Oak Ridge National Laboratory. Temperatures in the area have now decreased enough for personnel to enter and make a physical evaluation. Video cameras recorded the event and it is believed at this time that the vessel was overpressurized. A complete investigation and root cause analysis will be performed by the licensee to determine the cause of the event.

OPINION/COMMENTARY



THE ERWIN RECORD, Feb. 13, 2007

Letters to The Editor

No to incinerator

To the editor,

Radioactive waste incinerator. The words that were not mentioned to three very capable and competent mayors by Studsvik President Mike Hill.

Hill said he didn't publicly plan for the new incinerator because it seemed to be "such an inconsequential part of what we do." Look up the meaning of the word inconsequential. It is not logical with the words radioactive waste incinerator. Nor is it common sense.

Radioactive waste incinerator are very consequential words to a lot of people. Our mayors would have remembered them. If this incinerator is so safe, why doesn't Memphis want it?

If this is so safe, I'm sure Mr. Hill can find other towns and locations for such an "inconsequential part of what they do." Memphis doesn't want it, why would Erwin?

We absolutely do not want other people's radioactive and nuclear waste, nor radioactive waste incinerator. Mr. Hill, haven't you heard you take your garbage out – not bring it home with you? Not in our town and not in our backyard.

John and Wanda Sue Kelley,
Erwin

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Division of Air Pollution Control
9th Floor, L & C Annex
401 Church Street
Nashville, TN 37243-1531

March 4, 2009

Ms. Wanda Kelly
Member, Erwin Citizens Awareness Network
P. O. Box 1151
Erwin, TN 37650

Subject: Nuclear Fuel Services (NFS), Source 86-0002
Permitted Air Emissions

Dear Ms. Kelly:

This letter responds to your October 31, 2008, letter regarding Nuclear Fuel Services, Inc. (NFS) and emissions of air contaminants.

You ask how many regulated and hazardous air contaminants are there, what are regulated and hazardous air contaminants, and what is the quantity of each emitted air contaminant. Regulated facilities and activities must meet the applicable emissions standards and permitting requirements of the Tennessee Air Pollution Control Regulations. Regulated air pollutants include criteria pollutants (particulate matter, sulfur dioxide, nitrogen oxides, volatile organic compounds, carbon monoxide, and lead), and numerous (186) hazardous air pollutants (including categories of pollutants). Hazardous air pollutants consist of various metals and metal compounds, and certain mineral fibers, acid gases, volatile organic compounds, and non-volatile organic compounds. Although radionuclides are listed as hazardous air pollutants in the Tennessee Air Pollution Control regulations, the Tennessee Division of Radiological Health or Nuclear Regulatory Commission (NRC) is responsible for establishing source specific permitted emission limits of radionuclides. The mass limit exceedances and work practice failures you describe in your letter concern nuclear regulatory agency licenses and do not correspond to any conditions of a permit issued by the Tennessee Division of Air Pollution Control (TDAPC).

Your letter mentions the definition of an insignificant activity (or emissions unit) in parts 1200-3-9-.04(2)(a)3 and 1200-3-9-.04(4)(d)9 of the Tennessee Air Pollution Control Regulations. An insignificant activity has a potential to emit less than five tons per year of each air contaminant and each regulated air pollutant that is not a hazardous air pollutant, less than 1000 pounds per year of each hazardous air pollutant, and less than 0.1 millirem (mrem) per year of radionuclides. An activity that meets the criteria of this definition is exempt from the requirement to obtain a permit from the TDAPC.

As stated above, the TDAPC does not establish source specific permitted emission limits of radionuclides.

With regard to your specific inquiry about NFS' CD Line Process (Source 86-0002-53, Bldg. 301) potential air emissions, the TDAPC is a regulatory agency which issues permits based on current air regulations, especially Chapter 1200-3-9 for construction and operating permits. This proposed High Enriched Uranium Process was exempted from permitting on May 8, 2008, based on the Division's regulations [parts 1200-3-9-.04(4)(b) and 1200-3-9-.04(4)(d)9] and calculated potential-to-emit (PTE) emissions of regulated air pollutants. PTE emission calculations are performed based on a source's full capacity (production) operating continuously at 8760 hours per year (i.e., worst case) and are not based on just actual hours of operation which may be lower than 8760 hours. The PTE values of the reported pollutants were deemed insignificant at potential levels of less than five (5) tons per year of each regulated air pollutant, less than 1000 pounds per year of each hazardous air pollutant, and less than 0.1 mrem per year of radionuclides emissions. The calculated pollutant emissions are: particulate matter (0.703 ton/year), ammonia (0.31 ton/year), nitric acid (4.4 pounds/year), nitrogen oxides (3.13 tons/year), hydrofluoric acid (138 pounds/year), and carbon monoxide (6.0 pounds/year). Also a conservative estimate of the radiological emissions and the effective dose equivalent to the most exposed member of the public is projected to be 0.07 mrem/year.

With regard to your inquiry about NFS' overall emissions, this facility is currently permitted for the air pollutant emission limits shown in the attachment.

The TDAPC appreciates your comments and concerns regarding air pollution from permitted facilities in Tennessee.

If you have additional questions about NFS, please contact Haidar Al-Rawi at (615) 532-0578.

Sincerely,

John A. Zimmer

for Barry R. Stephens, P.E.
Director
Division of Air Pollution Control

cc: Tracy Carter
Debra Shults

JAT/HAA

ATTACHMENT

NFS Permitted Sources Emissions PTE (tpy)

Emission Source No.	PM	SO2	CO	VOC	NOx	NH3	HF	HCL	Hg	SiF4	Nitric Acid	H2S
86-0002-06	1.00											
86-0002-08	5.43	0.23	0.20	1.33	23.14	14.03	1.35	2.88	0.16	0.39	2.84	0.15
86-0002-12						63.51						
86-0002-21 (requested exemption 5/28/08)	10.00			0.00035	5.72				0.004			
86-0002-24	27.46	24.09	4.05	0.26	13.97							
86-0002-27 (requested exemption 7/11/08)				2.63		8.45						
86-0002-28 (OCB & EPB process)	0.05				21.00	33.00						
86-0002-28 (boiler)	0.20	0.02	2.20	0.10								
Total	**44.14**	**24.34**	**6.45**	**4.32**	**63.83**	**118.99**	**1.35**	**2.88**	**0.16**	**0.39**	**2.84**	**0.15**

HF, HCL, & Hg 4.39
SIF4, Nitric Acid, H2S 3.38
The rad dose to the public from the air effluents is less than 0.1 mrem.

LEGEND:

PTE=Potential-to-Emit
PM= Particulate Matter
SO2= Sulfur Dioxide
CO= Carbon Monoxide
VOC= Volatile Organic Compounds
NOx= Nitrogen Oxides
NH3= Ammonia
HF= Hydrogen Fluoride
HCl= Hydrogen Chloride
Hg= Mercury
SiF4= Silicon Tetrafluoride
H2S= Hydrogen Sulfide
mrem= millirem
rad= radiation dose

HAA
3/4/2009

The Atlanta Journal and Constitution, April 30, 1978

Nuclear Plant Leaks Waste, Raises Fear on Cancer Rate

By JOSEPH ALBRIGHT
Journal-Constitution Washington Bureau
1978 Cox Newspapers

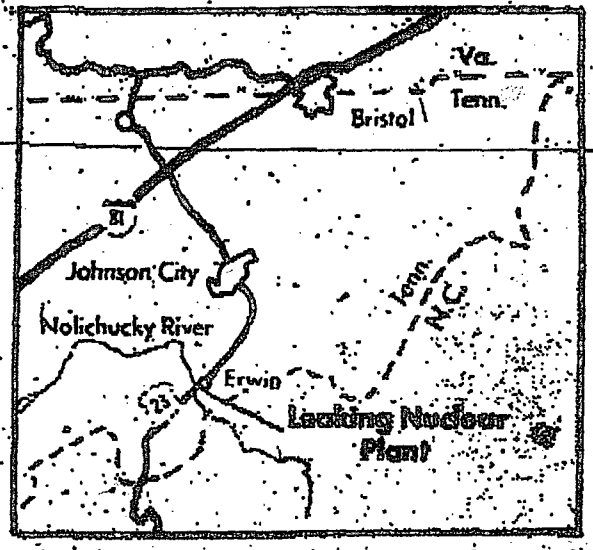
ERWIN, Tenn. — For the past 20 years, a factory producing nuclear fuel for the U.S. Navy has dumped its uranium waste into the swift-flowing Nolichucky River and scattered a light dusting of radioactive fallout on nearby houses. That may explain, even though the statistical sample could be too small to be scientifically valid, why the local cancer-death rate has doubled.

The factory, which sits about two miles from the Appalachian Trail, last year gradually poured 250 pounds of enriched uranium into the Nolichucky without notifying fishermen or a Tennessee hatchery which stocked the river with two million fish.

Cancer death figures for Unicoi County, assembled by a reporter with the help of a cancer expert, show the rate to be about twice what it was when the plant came here in 1957. And the intestinal cancer rate is substantially higher than that in adjacent counties.

Water in a spring flowing from the factory grounds was found to contain 700 times the natural background radiation in the area. The sample was scooped up by a visiting Cox Newspapers reporter and tested by the Nuclear Regulatory Commission at a government radiation laboratory in Idaho.

See ATOM, Page 20-A



A sample of muck from the bottom of the Nolichucky downstream from the plant was found to contain traces of radium, an intensively radioactive decay product of uranium. It was not known whether the radium resulted from the plant or from possible natural deposits of uranium, or both.

Last year, a state fish hatchery, unaware of any radioactive discharges, stocked two million baby walleyes in the Nolichucky several hundred yards downstream from the plant's effluent discharge point. Catfish, bass and a few trout are also caught near the plant by local fishermen.

NRC officials in Washington confirmed the uranium discharges. But they maintained that the Erwin plant is not a health hazard because the uranium, which escapes through the plant's filtration system, is "very extensively diluted." Ernst Volgenau, the NRC's chief inspector, said the overall radioactive concentration of the plant's effluent stream is well below current regulatory standards.

Radium has been known as a cancer-causing agent since the mid-1930s, when European doctors discovered a pattern of bone cancers among radium watch-dial painters. It is unknown whether very low levels of radium, such as those sometimes found in municipal drinking water, can also cause cancer.

One property of radium is that it tends to "go up the food chain" and accumulate in fresh-water fish, government scientists said. Most of it concentrates in the fish bones, NRC officials insisted.

—Ground Water Never Tested

NRC officials acknowledged that its recent environmental assessment of the Erwin plant did not mention radium or include any tests on the radiation levels in the local fish. They also acknowledged that Erwin's ground water — which is only three feet below the bottom of the plant's uranium settling ponds — has never been tested to see whether it contains radioactive contamination.

Erwin residents get their drinking water from mountain springs upstream from the plant. But Jonesboro, eight miles south, gets its municipal drinking water directly from the Nolichucky.

In theory, the 250 pounds of uranium washed down the Nolichucky last year was sufficiently enriched to make two crude atomic explosives, according to a document in the NRC public document room in Washington. The Navy uses the plant's output to make fuel rods for nuclear submarines and carriers.

The lost uranium belonged to the government. To produce another 250 pounds of a comparable enrichment would cost $235,000, a Department of Energy spokesman said.

The factory here plays a critical role in processing highly enriched uranium for fuel for Adm. Hyman Rickover's Division of Naval Reactors. It is owned and operated by Nuclear Fuel Services, Inc., a subsidiary of Getty Oil Co.

Rickover declined to be interviewed about the Erwin operation. Responding to a written question on the uranium effluents, a Rickover spokesman said: "Safe levels for discharge of nuclear materials to the environment are established by the Nuclear Regulatory Commission and are not the responsibility of Admiral Rickover."

Nuclear Fuel Services also declined comment, except to say that the figure of 250 pounds of uranium in its liquid effluent is "in the ballpark." Although there has been no announcement locally, documents on file with the NRC establish that the plant has been discharging about 50,000 gallons of waste water a day which contains a few parts per million of enriched uranium.

—Controversy Over Cancer

Disclosure of these uranium discharges — which have continued for two decades with the permission of the Atomic Energy Commission and its successor agency, the NRC — comes at a time of widespread scientific controversy over whether low-levels of radiation can cause cancer.

Perhaps by chance, the rate of reported cancer deaths in Unicoi County, which includes Erwin, is about twice as high as it was shortly prior to the opening of the nuclear fuel processing plant here in 1957.

Death records, obtained from the Tennessee State Center for Health Statistics in Nashville, also indicate that the mortality rate from intestinal cancer has been as much as 50 percent higher in Unicoi County than in the adjacent counties to the north and south. These statistics cover a three-year period in the mid-1970s and a similar three-year period 20 years ago.

The figures for Unicoi were assembled by Cox Newspapers with the help of a government cancer expert after B.E. Wilson Jr., manager of a local fish hatchery, said in an off-hand remark: "My wife and I have been wondering about the number of cancer deaths in the area. It has jumped more than we have ever known before."

Wilson knew of nine members of the 500-member Erwin Free Will Baptist Church who he said had died of cancer over the last five years. Several nationally recognized cancer experts said it was uncertain whether these variations are large enough to be statistically significant. Should the ages of the church members happen to match the U.S. national age breakdowns, five cancer deaths could be expected in a five-year period, one doctor said.

The NRC said there has never been a study of whether Erwin is actually a "cancer hot-spot," and if so, whether the plant's radioactive discharges might have anything to do with the seemingly higher level of deaths.

In addition to liquid wastes, the plant has acknowledged to the NRC that in 1977 it released an estimated five pounds of enriched uranium and a microscopic trace of plutonium through its smoke stacks. The plutonium was left over from a plutonium processing operation which ended at Erwin in 1972. Evidently, a few plutonium particles clinging inside air vents broke loose and went up a chimney.

Radiation maps submitted to the NRC in 1976 by Nuclear Fuel Service indicate that the uranium particles from the plant are deposited within a five-mile circle of the plant.

—By Appalachian Trail

In fact, the company maps show that a small quantity of measurable uranium is deposited two miles south of the plant — which is where the Appalachian Trail crosses the Nolichucky. Potential doses to hikers are far too small to be significant, a Department of Energy official insisted. Considerably higher concentrations, however, are shown on the company's radiation map within one mile of the plant — an area with a population of 3,700.

One company document, supplied to the NRC in 1976, indicates that the nearest residents, who live about 350 yards from the stacks, receive annual doses of lung radiation of up to 35 millirems. This is well below the then-existing NRC radiation standards.

But in 1977, the Environmental Protection Agency issued more restrictive radiation guidelines, which said no one living near uranium plants or elsewhere should absorb doses of more than 25 millirems.

The NRC, it was learned, then discarded the plant's own radiation estimates and issued its own environmental impact assessment on the Erwin plant. The new NRC report estimated that Erwin residents would receive no more than 3.4 millirems per year. The NRC assessment, sent to the EPA for routine clearance three months ago, did not mention that the plant had submitted an estimate that is 10 millirems higher than the current EPA standard.

Dr. Edward Shum, an NRC environmentalist, explained the NRC arrived at its lower radiation estimates by making a different assumption about wind velocity. The problem, he said, is that the plant's wind gauges are incapable of measuring wind speeds of less than two miles an hour. Therefore, the company assumed that when the wind gauges measured a dead calm, there was in fact a breeze of two-tenths mph.

In its follow-up study, the NRC assumed that the effluents are being blown away by a breeze averaging three miles an hour, even when the plant's wind gauge measures zero.

Shum said the company's estimates were discarded because its wind velocity assumptions were "overly conservative."

—Natural Radiation Sources

NRC officials also noted that Americans already receive about 100 millirems a year from cosmic rays and other natural radiation sources.

Erwin, a town of 5,000 people near the Tennessee-North Carolina border, is surrounded by Appalachian peaks, blossoming trees, steep wooded valleys, and small farms raising tobacco, strawberries and tomatoes.

Most tourists passing through never see the uranium plant, located on a side road on the edge of town. But security towers are visible from a four-lane highway which bypasses Erwin.

The plant, which employs about 400 local residents at wages of $6.30-an-hour and higher, is well regarded in this rural industrial enclave. Joe E. Frazier, the Erwin city recorder, said: "This is the most promising industry we have. They are expanding and hiring new people constantly. I don't know of any particular problems we have experienced with them. If there was any danger, I am sure they would advise us of it."

Bill Jones, a newspaper reporter and past president of the Erwin hospital board, said the town fathers brought the factory to Erwin in 1957 by providing a $200-an-acre subsidy to Davison Chemical Co., which was then looking for an out-of-the-way plant site.

The town was then seeking to recruit industry because local railroad employment was declining and a pottery company had gone out of business. About 10 years ago, the plant was bought by Nuclear Fuel Services.

"We'd rather have this than something like a textile plant, which would constantly smell," said Jones.

An analysis of the plant's 1977 radioactive effluent reports to the NRC shows that the company discharged 15 pounds of uranium-235 and 235 pounds of uranium-238 into the Nolichucky. Both have half-lives of one billion years, which means that they are only mildly radioactive. There was no report of radium discharges for last year.

But the liquid effluent also included one and one-half ounces of the little-known isotope uranium-234, a decay product of uranium-238, which is highly radioactive. When an atom of uranium-234 disintegrates, it decays into thorium and later to radium-226, which is even more radioactive. Radium-226, with a half-life of 1,620 years, occurs in nature only as a result of the disintegration of uranium.

The sample of Nolichucky River bottom sediments was found to contain about 50 picocuries of radium-226 per ounce. That is only about two parts per trillion by weight. But it is from two and one-half to 40 times the normal concentration of radium in soil and sedimentary rocks.

—Traces in Soil Samples

Traces of radium were also found in two soil samples from the river bank and a third soil sample dug inside the Tennessee State Fish Hatchery, which is 500 yards northeast of the plant. NRC officials said the exact amount of radium had not been estimated, but that the radium levels appeared to be part of normal "background" radiation.

A preliminary NRC analysis of water samples from the Nolichucky showed a slightly higher level of short-lived Beta emitting elements downstream than upstream. No breakdown of the radioactive elements in the water was available, but the total radioactivity level of the water appeared to be within EPA drinking water standards, officials said.

Atom

Continued From Page 1-A

The plant chemically processes about 780 tons of enriched uranium a year, some of it as much as 93 percent pure uranium-235. The effluent is cleansed in a waste treatment plant inside the plant's security fence and then discharged through a pipe into the Nolichucky.

Until the waste treatment plant was put into operation last December, the plant's treatment method consisted only of allowing the water to stand in unlined settling ponds on plant property.

After a period of time in the settling ponds, the effluent used to flow into Martin's Creek, a small local trout stream which empties after a few hundred yards into the Nolichucky.

Is Erwin an atomic Love Canal?

By TOM MADDEN
United Press International

Erwin, Tenn. — Scarcely noticed, workers wearing special security badges have passed for years through the prison-like gates of the Nuclear Fuel Services, Inc., plant to go about their hush-hush business of making uranium into fuel for the nation's atomic submarines.

Nestled near this sleepy community in the East Tennessee mountains, the plant opened quietly in 1957. For the most part, it operated with little fanfare, churning out fuel and spewing small amounts of radioactive dust into the atmosphere.

Of greatest interest to the city's 3,700 residents was it that it provided steady jobs and paychecks to some 450 workers.

Today, some people say the plant — a cluster of red brick buildings surrounded by a 10-foot high fence — has become a nuclear waste cemetery and is a ticking health time bomb.

Erwin is a typical Tennessee mountain town. To passersby, there are no clues that it lies within a few miles of one of the nation's vital defense establishments. Nuclear Fuel Services, a subsidiary of the giant Getty Oil conglomerate, is the only plant in the nation that fabricates uranium for use in the Navy's submarines. The military says it must stay open.

But the plant is, and has been, a production center for atomic materials. It also has become an atomic garbage dump.

For example, in addition to the uranium fabricating facility, there is a plutonium factory, ponds where radioactive uranium has collected and more than 200 spots where low-level atomic waste has been buried.

Environmentalists claim the plant has lived its nearly 30-year life and should be closed and cleaned up. They claim the operators have a "total disrespect" for the environment and the health of the people around the facility.

Federal officials said it is unlikely the plant will, or is, having any adverse impact on humans or animals. But officials admit radioactive uranium is being released into the air and the area's water supply.

Nuclear Regulatory Commission officials say there is no rule on how long a fuel fabrication facility can function and there are no current plans to dismantle the facility in the near future.

"A plant like this does not have a life expectancy," said NRC spokesman Ken Clark. "The license is for five-year periods, but there is no automatic cutoff. There could be a time when the plant could no longer meet regulatory requirements, then I guess it would have to be closed."

The plant has been a center of controversy in recent years. Since 1968 the plant has not been able to account for 245 pounds of the highly enriched uranium, enough to make several atomic bombs.

The Nuclear Fuel Services complex was shut down in 1979 because officials could not figure out what happened to 42 pounds of the high-enriched uranium. The plant reopened last March after all but 11 pounds of the material was accounted for and on the urging of Navy officials. A large part of the missing uranium was found caked in the floor and clogged in the equipment at the plant. One source said plant officials took jackhammers and tore up the concrete floor to retrieve some of the lost uranium.

The plant has been the site of several accidental releases of radioactive uranium into the atmosphere. In 1979, almost 3,000 grams of radioactive uranium were vented into the atmosphere. NRC officials stress no evidence of harm was reported from the release or other accidental discharges.

NRC officials say there has *been no evidence to indicate* any significant increase in cancer among the population.

Bob Lilly, an antique dealer from Jonesboro, has been active in a group protesting the plant.

"Here we have a dangerous plutonium facility, we have settling ponds that have overflowed on occasion, we have materials buried in the ground — what we have is a dumping ground like the Barnwell (S.C.) dump," Lilly said. "We know the radioactive uranium is being put into the atmosphere and it is seeping into and being flushed into the Nolichucky River.

"I don't know how people can say it is not doing any harm. What it boils down to is the defense needs outweigh the people of this area," Lilly said.

The plutonium facility, located away from the uranium processing center at the plant site, began processing plutonium for experimental and commercial reactors in the 1960s, but halted the operation in 1972.

The plant operators hope to dismantle the plutonium facility next year, but plans are uncertain because the authority has not been given to dispose of any plutonium-contaminated materials from commercial operations.

"The facility simply is not needed any more," Clark said.

Plutonium is a key element used in nuclear weapons and atomic reactor fuel and is one of the most toxic substances known to man.

Clark said the equipment and possibly the building where the plutonium operation was centered will have to be disassembled if disposal is allowed.

"At the present time I know of no specific agreement for the disposal of any plutonium," Clark said. "There is some contamination on the inside of the plant but we believe it could return to unrestrictive use."

Clark said low-level waste was buried legally on the site of the 57-acre compound, but he said no trash is currently being buried. He said the burials stopped in the "last couple of years."

Since the plant opened in 1957, more than 200 different sites were used to bury the waste. Clark said the buried materials contained radioactive uranium and thorium.

Clark said the plant operators do not have to report to the NRC when waste is buried.

"As long as the material is buried 4 feet deep and 6 feet apart they can legally do it," Clark said.

"We do not have complete records on how much is buried because for part of the time, the plant was under the supervision of the Atomic Energy Commission (now defunct)," he said.

The plant uses water in its system of fabricating the uranium and the liquid is sometimes discharged into two "settling" ponds. Here the uranium is allowed to settle to the bottom of the ponds and the cleaned water is then pumped into Banner Creek that runs into the Nolichucky River.

Clark said when the plant is closed the ponds will be drained and the uranium waste taken to a dumping area.

But environmentalist Lilly said the pond has a clay bottom and seepage problems are already present.

"We do not believe we are having a seepage problem, but we can't say we have never had a problem," Clark said.

"Some uranium is routinely discharged into the Nolichucky River, but they (plant operators) are allowed to do this," Clark said. "We have found that the river above the plant is more highly radioactive from background radiation than the river below the plant."

Clark said when the plant is closed, a decision will have to be made on what to do with the buried waste.

"It might be better to leave it where it is," Clark said.

Clark said the Erwin plant could be closed and cleaned up. He said a similar operation, the privately owned U.S. Nuclear Fuel facility in Oak Ridge, Tenn., was cleaned up and no restrictions are now in place on use of the land.

Clark said Nuclear Fuel Services is presently upgrading its equipment and there are no immediate plans to close the Erwin facility.

NRC leaders, however, have specified that plant officials place $516,000 yearly in an escrow account to pay for the cost of closing and cleaning the plant.

Clark said NRC officials would not anticipate any problems in getting the plant closed and cleaned up.

"We don't believe we would have any problems here. If we did, we could bring the weight of the federal govenrment to bear," Clark said.

But the closing of a plant owned by Nuclear Fuel Services near Buffalo, N.Y., has become a controversial issue. The plant reprocessed atomic fuel and shut down because of prohibitive costs of meeting stringent earthquake resistance guidelines.

There are 600,000 gallons of highly radioactive liquid wastes in two underground tanks at the West Valley plant and 170 tons of spent nuclear fuel rods are being kept in a large water pool at the plant.

The New York State Energy Research and Development Authority calls West Valley a "symbol of the nation's failure to cope fully with the back end of the nuclear fuel cycle."

The federal government has agreed to pay 90 percent of the cost of solidifying the liquid wastes and perhaps transporting it to an as yet-undetermined federal repository. A place for disposing of the spent fuel rods also has not been selected.

The plant is currently involved in a state lawsuit with New York over who has responsibility for low-level waste buried at the site.

The federal Energy Department expects to spend about $5 million this year on preliminary studies on ways to clean up the site.

Lilly said his group has been concerned that Nuclear Fuel Services could pass the costs of closing and cleaning of the Tennessee plant off on state or federal officials.

"People know these folks' track record. I think New York brought that out. It is a very big concern that the taxpayers will eventually have to pay the bill for cleaning up Erwin," Lilly said.

Nuclear Fuel Services, headquartered in Rockville, Md., is required to put up the $516,000 until the escrow account reaches $5.2 million.

"That wouldn't go anywhere near paying for the cleanup," Lilly said.

Clark said the Tennessee and New York operations could not be compared because the Tennessee facility is a fabrication plant handling natural uranium, while the New York reprocessing plant dealt with highly radioactive materials.

"It is hard to get people to listen up here. The nuclear plant is the largest employer and pays good bucks," said Lilly. "I'm afraid of what the plant might be doing to people's health and the environment."

KINGSPORT TIMES-NEWS
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A big job for a little town

The people of Erwin may be giving more than their share for 'national security'

John Egerton

When the Davison Chemical Division of the W.R. Grace Company decided to build a plant in the Tennessee mountain town of Erwin twenty-four years ago, leaders of the little community were so pleased that they helped to raise some money for the purchase of a plant site on the nearby Nolichucky River.

Erwin needed industry. Development in the town and surrounding Unicoi County had been stymied by poor roads and a lack of usable land; the U.S. Forest Service controlled almost half of the county's 185 square miles, and most of what remained was unsuitable for farming. Some factory jobs were available in Johnson City, twelve miles to the north, but for many Unicoi Countians, finding work meant leaving home—and each year, scores did.

The Davison plant put a few dozen local people to work in a complex chemical process involving atomic materials. The process was not well understood locally, but assurances were given by the U.S. Atomic Energy Commission, which had supervisory responsibility for the operation, that the work was not dangerous. The people of Erwin, happy to have a new payroll in town, accepted the assurances.

For more than a decade, Davison prospered in Erwin. In the mid-1960s, the company landed a lucrative Federal contract to process fuel for the U.S. Navy's nuclear submarine fleet. Additional workers were hired, and Davison changed its name to Nuclear Fuel Services. In 1968, the Nuclear Regulatory Commission replaced the Atomic Energy Commission as the Government overseer of the plant, and a year later, W.R. Grace sold the enterprise to the Getty Oil Company.

Now, Nuclear Fuel Services (NFS) is the central pillar of the Unicoi County economy. According to the local newspaper, the company employs more than 600 workers and has an annual payroll of $12 million. The 325 hourly-wage employes, all members of the Oil, Chemical and Atomic Workers Union, earn an average of $8.33 an hour. Thanks in large measure to NFS, per capita annual income in the county now exceeds $5,000, and the unemployment rate is less than 5 per cent.

At first glance, the transformation of this isolated mountain town from poverty to moderate prosperity seems to be a classic example of community achievement through industry. But a closer look reveals a starkly different picture.

Off and on for the past decade, and almost continuously since 1979, Erwin has been gripped by strife and controversy, and NFS has stood in the center of the storm. Its business, for "reasons of national security," has been shrouded in secrecy, and its officials have maintained a posture of public silence. The Nuclear Regulatory Commission (NRC) has alternately penalized the company for safety infractions and served as its interpreter and defender. The union has accused the company of violating health and safety standards—and with equal vehemence has assailed some of the company's critics as "outside agitators" and "communists." The roster of critics has included local and national anti-nuclear groups, commissioners and staff members of the NRC, several physicians in Erwin and Johnson City—and both local and national representatives of the union itself. Local officials, including the mayor—who is also the NFS company doctor—have steadfastly supported the company, and newspapers in the area have tended, in the main, to ignore the controversy altogether.

If it is hard to tell the players in this fracas without a program, it is even more difficult to determine where the truth lies in the tangle of fact and fiction, rumor and innuendo, hard questions and highly technical responses surrounding it. There are, however, at least three generally accepted facts:

¶ On three or more occasions in the past, the NFS plant has accidentally released into the atmosphere a cumulative total of more than forty pounds of radioactive uranium hexafluoride.

¶ On numerous occasions since 1968, NFS has been shut down by the NRC after routine inventories showed that excessive quantities of highly enriched uranium could not be accounted for. Total losses have never been disclosed by the NRC, but published figures have ranged to 400 pounds and more.

¶ Records of the company and the Atomic Energy Commission for the years before 1968 are so inadequate that no one seems to have any idea how much radioactive material was acci-

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dentally released or carelessly lost at the Erwin plant during those years. There is little doubt, though, that the totals were higher then than they have been since.

From these facts, belatedly reported and inadequately explained, has arisen a rash of stories that blend truth and fancy and spread fear in the community: that a lack of care in the operation of the plant has caused some workers to be contaminated by radiation; that these "hot" workers, once disabled, would be dismissed without compensation; that the cancer rate in Unicoi County doubled in the first twenty years of the plant's existence; that radioactive wastes have been routinely dumped into the river and buried both on and off the plant site; that the missing uranium was stolen for terrorists to use in making nuclear bombs; that the plant is so contaminated that NFS will soon abandon it, leaving the community with a permanent cancer threat and an empty purse to pay for the damages.

These expressions of alarm began to bubble to the surface in 1979, shortly after the settlement of a long and bitter union strike, when two disturbing disclosures were made by NRC officials. The first was that an undetermined amount of uranium hexafluoride had accidentally been released into the atmosphere at NFS on August 7. The second was that a routine bimonthly audit of radioactive materials at the plant had revealed a shortage of more than twenty pounds of uranium.

After the inventory discrepancy was reported in September, the five-member regulatory commission ordered a shutdown of the plant while Federal investigators, including FBI agents, conducted an intensive search for the missing uranium. Four months later, with the investigation still incomplete, the Navy's Admiral Hyman Rickover told the NRC that fuel processing at the Erwin plant was vital and indispensable to the national defense, and the commission promptly voted 4-to-1, with member Victor Gilinsky dissenting, to reopen the facility. Safety and security regulations were tightened, but accounting standards were actually relaxed, permitting NFS to have uranium shortages of more than twenty pounds in each two-month inventory period; exactly how much more, NRC officials would not say.

Throughout 1980, NFS continued to process nuclear fuel for the Navy while the people of Erwin waited anxiously for the NRC to account for the missing uranium and to assess the consequences of the accidentally released radioactive particles. Finally, in October, more than a year after the two incidents, the commission announced that virtually all of the inventory shortage had been traced to the plant's ducts and smokestacks, its waste disposal systems, and its walls and floors. The exact amount of uranium lost in the two-month period was not made public, but individuals in a position to know placed the total at forty-eight pounds.

As for the consequences of the atmospheric release, which was calculated to be 300 to 3,000 grams (up to 6.6 pounds), NRC officials concluded that under the worst possible weather conditions, "the [radiation] dose to the bone of a child at the nearest residence would have been twenty-one Rems." (A "Rem" is a complex measure of radiation exposure equivalent to about seven micrograms. Maximum allowable exposure of workers at the Erwin plant is 210 micrograms, or thirty Rems a year in the lungs. It is estimated that Americans receive about one-tenth of a Rem of radiation a year from natural sources and the environment.) The NRC officials went on to say that since the weather conditions at the time of the accident were not unfavorable, and since no one was known to have inhaled the released material, the risk to persons in the plant vicinity was thought to be minimal.

These developments did little to settle the community's jangled nerves. At a public meeting in Erwin last December, and again in a closed session with local physicians the following month, NRC officials stoutly maintained that in spite of all the alarms about accidents and missing uranium, NFS had never come close to exceeding the Government's health and safety standards, and the company's twenty-four-year presence in Erwin had done no measurable damage to workers, residents, or the environment. But just as insistently, one speaker after another rose to question the performance, the motives, and even the veracity of both the company and the NRC.

Among the questions were these:

¶ A 1978 study by the U.S. Public Health Service's Center for Disease Control showed a marked increase cancer deaths in Unicoi County, bu

concluded that the small size of the population sample and its higher-than-average age made the findings "statistically insignificant." But the NRC, which officially encouraged the initial study, has shown no interest in the Center for Disease Control's recommendation that follow-up studies be made in the county periodically. Why is the NRC reluctant to endorse close professional monitoring of cancer deaths in the vicinity of the plant?

¶ Just two miles beyond the river and over the mountain from NFS, a notorious chemical waste dump known as Bumpas Cove was finally shut down after official and private complaints that it posed a serious health hazard. NFS has consistently denied that any of its wastes were ever dumped there, but former employes of the company say they have witnessed such dumping. What is the truth of the matter, and what responsibility, if any, should NFS have for cleaning up Bumpas Cove?

¶ Does NFS, like a nuclear power plant, have a probable life span of three decades or so, and does that suggest that the Erwin facility is apt to be closed permanently in a few years? Is NFS looking toward such a move? Is NRC in favor if it? What would become of the plant buildings? Would they be left contaminated? Who would make them safe? And finally, how could the Unicoi County economy sustain the loss of a $12 million payroll?

¶ Continuous environmental monitoring by NRC has indicated no measurable radiation effects to water, soil, and plant life in the area. But an Atlanta newspaper reporter claimed in 1978 that soil and water samples he took from Erwin were tested by NRC officials and found to contain 700 times more radiation than the official NRC samples. What is the explanation for this discrepancy?

¶ To how much radiation have area residents been exposed over the years, and what has been the cumulative effect? Or as one questioner put it, "If the stuff builds up and doesn't decay for a quarter of a million years," does that mean that the radiation problem gradually grows worse and worse?

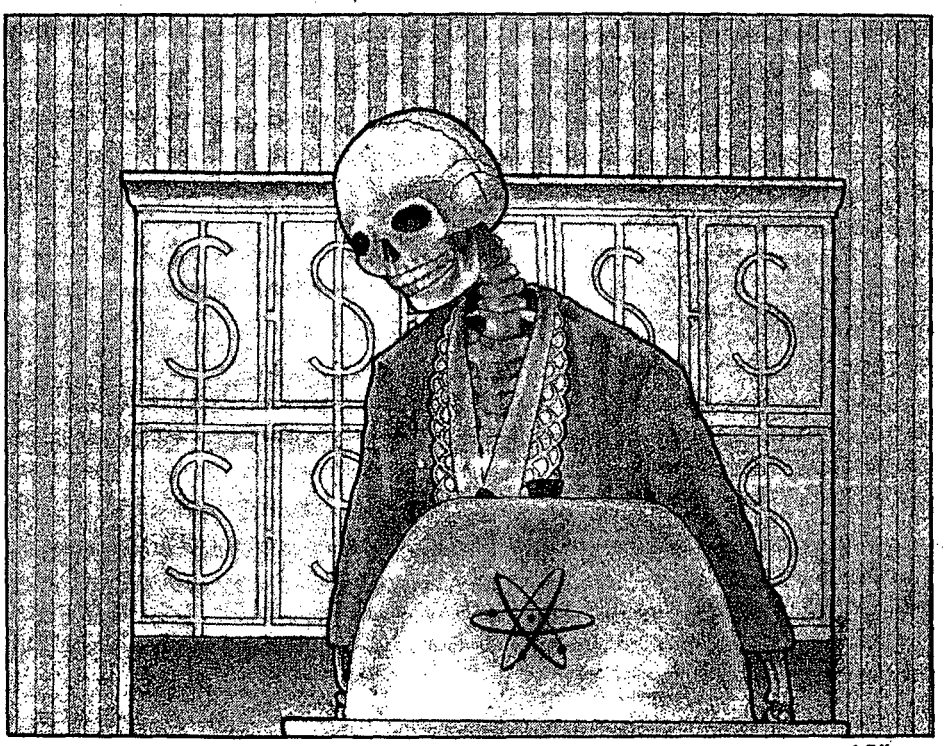
¶ Finally, this question, posed at the public hearing to a top official of the NRC: "Is this plant being monitored twenty-four hours a day by somebody from your office that knows what is going on there that can tell me that that plant is safe today and will be safe tomorrow and next week and next month and ten years from now? That is what I want to know."

The answers provided by NRC and plant officials to these hard questions have been detailed and exceedingly complex, filled with scientific data and the mystifying terminology of nuclear science. Stripped to their essence, the answers seem to say this:

"There is nothing to fear. The uranium materials handled by NFS are not fissionable, not by themselves explosive, not even highly radioactive. We have elaborate safeguards to minimize their danger, and NFS has never exceeded the critical boundaries of safety. Workers in the plant have not been seriously contaminated by radiation, nor have residents of the community. This is not a dangerous place to work or to live. Among doctors and nuclear scientists there is much disagreement on the effects of exposure to radiation, but our medical and scientific specialists assure us that the massive body of evidence supports the position that no adverse health effects have resulted from the presence of this plant in Erwin."

Some thoughtful listeners to this dialogue say they are reassured by what they have learned; others remain skeptical. At the very least, the exchanges have lowered the town's temperature and brought back a measure of tranquillity. Conversations in stores and offices and on street corners—particularly conversations with strangers—are still guarded by suspicion and uncertainty, but there is at least some willingness to talk.

"I wouldn't want to be quoted on this," a retired NFS employe said. "I'm living here by choice, and I want to stay. But I'll tell you this much: I don't agree with the NRC. There *is* a danger here, no question about it. By their own admission, the plant has lost hundreds of pounds of high enriched uranium down through the years. What happened to it? It was buried, poured out, reprocessed, maybe even stolen. Nuclear power, in my opinion, is safe—it's people that make the risk. This plant could be made as clean as a brewery, and kept in use for years and years. It's like a baby: it needs its diaper changed—and if they can't do it, we better get us a new babysitter. I'm not at all interested in seeing the plant shut down or moved. I just want to see



Jeff Kopseng

Drs. Jim + Ann Fingar : Dr. John Strimas

it cleaned up and run right. But if they keep losing uranium, it'll be the end of all of us. Radiation is like God—you can't hide from it, and if you don't respect it, you'll be called to pay for your sins."

"People around here," said Sheriff Roby Osborne, "would lots rather work than take welfare. They'll stand up and fight for their jobs. There's all kinds of feelings about that plant—there's fear—but we need the payroll. I'm one to think that if you appeal to good judgment and common sense, you can work anything out. What we need is some clear answers. Why is there so much security out at that plant, and so much controversy? People fear what they don't know. I'd like to see the place corrected, not closed. We've gone too far to turn back. The plant and the Government need to be honest with the people who work there and the ones that live in the community. How much radiation are we getting? Nobody knows enough about the dangers. It's not that people are against nuclear power—they just want care and caution, and no coverup. I think everybody understands that it's not a power plant out there—there won't be a meltdown, or a radiation blanket—but what are the risks we're taking? What most people feel, I think, is that it might be dangerous to work there—but the greatest danger is that NFS might run off and leave. If that happens, this town will die."

Lonnie Tolley is president of the union local. He is proud of the fact that 100 per cent of the eligible workers at NFS belong the union. When he led them through a four-month strike in 1979, the key issues were said to be health and safety—and, in particular, a provision that workers exposed to "more than the maximum allowable radiation" would receive long-term disability protection.

"We got basically what we were after," Tolley says. "Since we've been back to work, the company has been doing a better job to make it safe, and NRC is holding them to it. I'm pronuke, and I feel it's safe. If it wasn't, I wouldn't be there—and I've been there fifteen years. We've never had a fatality at the plant, and very few accidents. There are hazards, the same as you'd find in a coal mine, or working with asbestos, but it's not like the antinuke people say it is. They all come in here from someplace else, causing trouble. They don't care that this plant is important to the community and vital to the country—they just want to shut it down. I don't mind the doctors asking questions. They live here, and it shows their concern. The more information we have, the more facts, the better. But we don't need outsiders raising hell. If any hell needs raising, we'll do it ourselves."

'I'm not sure that anyone knows all the facts—and some people are scared to see them come out'

Jim Fingar and his wife Ann, both physicians, came to Erwin to practice in 1979, when the community was in turmoil, and they soon found themselves in the midst of it. At the public hearing last December, Jim Fingar asked some penetrating questions. NRC has answered them and others in a thirty-four-page document. "It's a good start," he says, "but we need more. I don't think they're being evasive. They're trying to help, but this is complicated stuff, and there's a lot that even they don't know. I'm not sure that anyone knows all the facts—and some people are scared to see them come out. I'm not asking that the plant be closed. I haven't seen anybody dropping dead from cancer. The plant could probably be made to operate safely with proper regulation. I'm just concerned—many people are—and I'm trying to get answers."

Besides the Fingars, one more of the eight physicians in Erwin has publicly expressed deep concern about the unknown consequences of uranium mishandling at NFS. He is John Strimas, a pediatrician who has practiced in Erwin for the past four years. Strimas says his slowly growing awareness of people's anxiety about problems at the plant "led me into a long process of self-education that is still going on. After the recent efforts of the company and the NRC to address our questions, I feel much better. I hope when all the facts are in, we will feel confident that if the plant is operated strictly according to regulations and no accidents occur, it will pose no threat to people or the environment.

"But much more information is needed," Strimas adds, "on such matters as the long-term effects of low-dose radiation and the safe disposal of radioactive wastes. The Center for Disease Control study of cancer deaths needs to be resumed, with continuous monitoring. Those of us who are physicians are in a position to lead the way to a solution of this community problem. We have a bonafide need to know all the facts, and when the facts are in, we can convey them to our patients, who make up the community. NRC and NFS have a credibility gap here, but my patients trust me. If I can say to them, 'All our questions have been answered and the truth is very reassuring,' then there will be strong support for the company, because the jobs it provides are absolutely vital to the local economy. But if I have to tell them that we could not get all the facts, or that the facts don't support our hopes, then we will face some serious difficulties."

While the slow process of fact-gathering proceeds, NFS continues to operate under the watchful eyes of workers, Erwin residents, and the NRC. It is the only plant in the United States processing uranium hexafluoride into tiny spheres of carbon-coated nuclear fuel to power the reactors in the Navy's submarines and aircraft carriers. "It's strange how this little town ended up with this important job," an Erwin resident mused. "It makes some of us proud, and as far as the money goes, it's been a blessing. What we don't know, and what we're waiting to find out, is whether th blessing is turning out to be a curse."

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Little progress made at nuclear plant

By Greg McDonald
and Joseph Albright
Journal Staff Writers

Despite a history of waste discharge problems and a consistently high cancer death rate in the surrounding county, an Erwin, Tenn., nuclear fuel plant still has an inadequate program for controlling and measuring radioactive waste released into the environment, according to a recent report by the Nuclear Regulatory Commission.

Because of concern over the continued discharge of uranium effluents from the facility, the Centers for Disease Control has begun a new study of cancer deaths in Unicoi County, where the plant is located.

The cancer death rate remains higher in the rural area than the state average or that of surrounding counties, according to 1981 statistics obtained from the Tennessee State Department of Health.

Initial research completed in 1979 concluded that a dramatic increase in Unicoi cancer deaths between 1957 and 1977 could not be linked to the plant discharges. But because of a latency period of five to 30 years following exposure, the research team conceded that several more years of testing would be necessary before it could be certain that no link exists.

The first 14-month study blamed most of the deaths on a gradual increase in the average age for the county's population of 16,285. But the researchers expressed concern about the "unexpected" increase in leukemia, often viewed by cancer specialists as the first sign of a link to radiation exposure.

There were six leukemia deaths in the county during 1975-1977 as compared to nine over the two previous decades. There

SEE Nuclear 9A

have been four more during the last 3½ years.

"That may or may not be high," says Dr Glyn Caldwell, chief of CDC's cancer research branch in Atlanta. Caldwell ordered the follow-up study after learning of an Oct. 7 release of 100 grams of uranium fluoride gas from the top-secret facility.

The plant, operated by Nuclear Fuels Services Inc., a subsidiary of Getty Oil Co., is the Navy's sole supplier of nuclear fuel. It processes highly enriched uranium into a powdery material which is molded into fuel rods for the Navy's fleet of nuclear submarines and aircraft carriers.

"We are bothered, if you will, that there has been a slight increase. We know that radiation causes cancer and we know that there have been releases," Caldwell said. "That's why we're continuing to watch it."

The CDC began its first study after a 1978 investigation by The Atlanta Journal-Constitution revealed the NFS plant had been dumping 250 pounds a year of enriched uranium into a nearby river and venting radioactive fallout on surrounding homes. For 20 years, first the Atomic Energy Commission and, later, the NRC, which now is responsible for monitoring the facility, failed to stop the plant from making the discharges.

The newspaper also reported the cancer rate in the area around the plant had increased dramatically since the plant opened in 1957.

The reports were cause for concern among some county residents who questioned the reliability of waste control and monitoring procedures at the plant during a public hearing in December of last year.

But they were assured by NFS, which operates the facility under contract with the government, that radiation releases have always been within the licensing limits established by the NRC. The NRC also insisted that the releases posed no health hazard to the surrounding communities.

However, despite such assurances, a Sept. 29, 1981 NRC report indicates that a number of possible health and environmental hazards continue to exist at the plant. The NRC has ordered the plant to install new waste treatment facilities in hopes of reducing radioactive discharges, but they won't be in place until December 1982.

The September report, containing observations by NRC officials, covered the following problems:

- Quality assurance program — "a significant weakness in the plant program for effluent and environmental monitoring has been the lack of a good quality assurance (or control) program," NRC officials noted. "This also applies to other health physics/radiation protection measurements."
- Outside contaminated control areas — "the surfaces (asphalt, soil, etc.) in these areas have been permitted to become contaminated to the limits specified in the license. The contamination is resuspended into the atmosphere and also discharged from plant environs through surface water runoff. The licensee has no control over the quantity discharged nor is the licensee able to satisfactorily measure the quantity of material released."
- Groundwater monitoring — "In addition to the potential migration of radioactive waste from the treatment ponds to the groundwater, NFS has buried waste lines which could leak and a solid waste burial ground on-site from which contamination could be released to the groundwater. Currently, only one well is used to monitor the burial site, the design of which is not understood."
- Devices measuring release of radioactive particles — "a comparison of the results shows very poor correlation between the primary and redundant stack samples," the officials wrote of devices which measure the amount of uranium particles often vented up smokestacks during the chemical process which converts the uranium into nuclear fuel.

"Consequently the representativeness of the stack sampling is questionable," NRC officials concluded.

In its first study the CDC relied on effluent measurement data supplied by the NFS plant and the NRC to use in calculating radiation exposure to county residents. But if that information was wrong, Unicoi residents could have received larger doses of radiation.

"If we correct for aging (in the new study) and it still looks like the cancer rate is increasing, there could be something wrong with the exposure data," said Dr. James Ruttenber Jr., who will coordinate the CDC research. "They really haven't, in the past, come up with accurate off-site monitoring methods that would adequately reflect what those people are being exposed to," he continued.

Current health statistics indicate that from 1972 through August 1981, the county cancer death rate has been consistently higher than the rest of the state. If dangerous levels of radioactive discharges have been occurring with any frequency since the plant opened, it would take anywhere from five to 30 years for it to have an effect on the local population.

Erwin N-fuel plant called 'nightmare'

by RICHARD POWELSON
News-Sentinel Washington bureau

WASHINGTON — The Nuclear Fuel Services plant in Erwin, the sole supplier of fuel to U.S. nuclear submarines, is "the most dangerous" of five U.S. uranium fuel production plants because of inadequate controls over radioactive material, a House subcommittee has found.

Several areas inside and outside of the East Tennessee plant, which has 360 workers, have been contaminated by radioactivity in recent years, said Rep. Edward Markey, D-Mass., the chairman of the House energy conservation and power subcommittee.

Markey's subcommittee has been investigating the plant's operations and is scheduled to hold a hearing today to find out why the Nuclear Regulatory Commission has not done more to require safety at the plant.

"The NFS plant is a toxic nightmare," Markey said, "oozing radioactive contamination into work areas, into lunchrooms and vending machines ... onto the soil outside work buildings, into groundwater and on railroad land off site."

The plant has been fined by the NRC much more ($102,000 since May 1984) than four other uranium processing plants in the United States, Markey said, and many problems remain unresolved.

In today's hearing, NRC's five-member commission will be asked why they have not taken action to require cleaning up three inactive ponds on NFS grounds after a 1984 test showed some radioactivity in the ponds had migrated into groundwater. Markey is interested in when and how 30 pits of buried radioactive waste at the plant will be decontaminated.

NRC documents show that an NRC inspector investigating complaints of radioactive contamination in plant lunchrooms found 6,000 disintegrations per minute (dpm), a measure of radioactivity, outside a milk machine in April 1985. The plant's maximum allowable level is 5,000 dpm, the NRC said.

Markey's subcommittee also plans to ask the NRC why they allow the 5,000 dpm level at the Erwin plant when most other uranium processing plants have maximum allowable limits of 100 to 200 dpm.

NRC documents Markey obtained show that NFS had to bury parts of some lunchroom vending machines with radioactive contamination at a licensed dump in late 1978 or early 1979 because the parts could not be "cleaned satisfactorily."

NFS is the only highly enriched uranium processing plant in the country, but there are four other plants (in Missouri, Washington state, North Carolina and South Carolina) which process mostly low enriched uranium.

Charles Taylor, NFS president, said through a spokesman that all of the safety problem allegations made by workers had been investigated by the NRC and were found to be unsubstantiated. In nearly 30 years of operation, NFS has been a safe place to work and has never had a work-related death, he said.

But the union representing the plant's workers, the Oil, Chemical and Atomic Workers Union, will have a representative testify today that 25 to 30 of the plant's 360 workers have complained recently of having kidney-related illnesses. Nolan Hancock, legislative director of the union in Washington, said the illnesses may be related to workers ingesting uranium particles, and he is calling on the NRC to conduct a health study soon on the kidney illnesses.

"We work with many nuclear plant personnel across the country and we're not hearing many complaints from them (about kidney problems)," Hancock said. "When we heard from 25 to 30 workers at Erwin, it set off a bell in my head. That's why we're seeking a health study."

Story last updated at 1:06 p.m. on Monday, February 14, 2000

Nuclear fuel plant in unlikely place

by Angela K. Brown
Associated Press

ERWIN -- Tucked away in this small town in the northeast Tennessee mountains, Nuclear Fuel Services Inc. has worked on top-secret projects in relative obscurity for nearly half a century.

Few outside the community have known the company -- some 500 miles from an ocean -- is the sole supplier of fuel for the U.S. Navy's fleet of nuclear-powered submarines and ships. And that's how the company liked it.

But with the end of the Cold War, the plant's activities have become more visible. Officials still don't say much about the fuel process, and plant security remains tight. But they will freely discuss other projects, such as cleaning up toxins at U.S. Department of Energy sites and converting nuclear weapons material into fuel for commercial power plants.

"There's a lot of sides to NFS," said company president Dwight Ferguson.

The plant opened in 1957 in Erwin, current population 5,700, to be near government nuclear installations in the Southeast, including Oak Ridge and the Savannah River Site in South Carolina. It initially made specialty fuels for nuclear reactors. The plant had several owners through the years, including Texaco, and now is owned by NFS Services Ltd.

In the late 1960s, Nuclear Fuel Services began making highly enriched uranium to power the U.S. Navy. Over the years, it has produced some $5 billion worth of the material for the nuclear fleet.

The end of the Cold War reduced the Navy's fuel needs and its contract with the Erwin plant was canceled in 1992. More than half the company's 800 employees were let go.

Looking for new work for its 65-acre complex, the company became involved in "downblending" high-enriched uranium warhead materials to low-enriched uranium for commercial nuclear power plants. NFS also got involved in environmental cleanup projects.

The company resumed fuel production for the Navy in 1996, under a contract extending through 2002, but still has nongovernment clients. Last year the Nuclear Regulatory Commission renewed the company's nuclear materials license through 2009.

Nuclear Fuel Services now has about 525 workers and, as the largest employer in Unicoi County, is heavily involved in the community. The company started a school reading incentive program that involves some 30,000 local students.

"They certainly are a good corporate citizen, and they mean a lot to the tax base of the county," County Executive Paul Monk said.

But the plant has not been without problems. Some groundwater is contaminated by technetium-99, a uranium byproduct that spilled at the plant in 1998. The NRC said last month it still does not know the size of the contaminated area or how it will be removed.

NRC officials said the shallow groundwater eventually may discharge into the Nolichucky River, which provides drinking water for the town of Jonesborough. But Nuclear Fuel officials said they are developing a cleanup plan and that the contamination has not affected anything off the plant property.

The commission's annual review of the plant, issued last week, cited some problems with employee safety. And some residents have told local leaders they fear an incident could endanger the nearby industrial park, shopping center and dozens of homes -- as well as the area's scenic beauty.

"Erwin is not the part of the country that you'd want these materials to be handled in," said Stephen Smith, president of Foundation for Global Sustainability, based in Knoxville.

Some Erwin residents said they were concerned after the September nuclear accident at a uranium-reprocessing plant in Japan, when two workers mixed too much uranium with nitric acid to make fuel. One worker later died and more than 400 people were exposed to high levels of radiation.

But Nuclear Fuel Services workers handle uranium in "geometrically safe" containers designed to prevent such an incident, Ferguson said.

Other problems have been reported at the Erwin plant through the years.

A 1979 uranium release exposed about 1,000 people to high levels of radiation, according to some reports. The NRC said it has no records of how many people were exposed.

In 1996 an incinerator caught fire, but company officials said it caused no injuries or radiation contamination. The NRC said plant workers had improperly implemented or had not maintained corrective measures mandated after a similar fire there in 1983.

Ferguson said no major incidents have happened in recent years. Employees wear protective gear and devices that monitor their exposure to radiation. Results of air and water samples taken at and around the plant are reported to the state.

The state has not issued any orders or civil penalties against the company, said Eddie Nanney, director of the Tennessee Department of Environment and Conservation's Division of Radiological Health. Allegations of wrongdoing have surfaced during union negotiations but were unfounded, he said.

"There were persistent rumors many years ago that kept cropping up ... that NFS had made untreated releases into the river," but the state found no evidence supporting those claims, Nanney said.

02/14/00, "Nuclear Fuel Plant is Unlikely Place"

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