UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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JUL 1 8 1990

MEMORANDUM FOR: Thomas T. Martin, Regional Administrator
Region I

Thomas E. Murley, Director
Office of Nuclear Reactor Regulation

Jack R. Goldberg, Assistant General Counsel for Enforcement
Office of the General Counsel

FROM: James Lieberman, Director
Office of Enforcement

SUBJECT: OI REPORT 1-90-006 CINTICHEM INCORPORATED: INCOMPLETE AND INACCURATE INFORMATION TO NRC

This report concluded that, based on Region I's May 30, 1990 memorandum (Exhibit 5 of the OI report), Cintichem Inc. did not violate the requirements of 10 CFR 50.9. Given that conclusion and the fact that the licensee was cited for the technical violation (exceeding radioactive discharge limits) in Combined Inspection Report Nos. 50-54/90-80 and 70-687/90-80, dated March 19, 1990 this report is considered closed.

James Lieberman, Director
Office of Enforcement

cc: H. Thompson, DEDS
~~J. Partlow, NRR~~
B. Hayes, OI
S. Weiss, NRR

FOIA-90-401 B-15

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CONVERSATION RECORD

TIME: 2:30 pm
DATE: 8/7/90

TYPE
☐ VISIT ☐ CONFERENCE ☒ TELEPHONE
☐ INCOMING
☒ OUTGOING

Location of Visit/Conference:

ROUTING	
NAME/SYMBOL	INT
Mal Knapp	
Tim Martin	
Bill Kane	
Ron Bellamy	
Bob Bores	
Jerry Roth	
Tom Dragoun	
Mike Austin	
Karl Abraham	
S. Weiss, NRR	

Docket Nos. 50-54
70-687
Dick Cooper

NAME OF PERSON(S) CONTACTED OR IN CONTACT WITH YOU: Jim McGovern

ORGANIZATION (Office, dept., bureau, etc.): Cintichem

TELEPHONE NO: 914 351 2131

SUBJECT: CAL 1-90-005

SUMMARY

I told Mr. McGovern that we were prepared to send him a letter relieving him of the subject CAL, but would like him to continue to notify us whenever they make a release from the retention pond. This should be done at same time NY State notified, and the call to NRC should be through the Duty Officer. He agreed fully to this commitment, and was pleased we were taking the action

ACTION REQUIRED

None

NAME OF PERSON DOCUMENTING CONVERSATION: J. Joyner

SIGNATURE: JT Joyner

DATE: 8/7/90

ACTION TAKEN

SIGNATURE

TITLE

DATE

OTHER EVENTS OF INTEREST

The following item is described because it may be perceived by the public to be of public health or safety significance. The item did not involve a major reduction in the level of protection provided for public health or safety; therefore, it is not reportable as an abnormal occurrence.

1. <u>Releases to Indian Kill Reservoir by Cintichem, Incorporated, Tuxedo, New York</u>

On April 4, 1990, licensee management announced a decision to decommission the reactor and hot laboratory facilities. This decision was made after an in-depth analysis on the long-term economic viability of the reactor. The licensee will prepare a detailed decommissioning plan for submission to the NRC for its approval.

Prior to the decision to decommission, on February 9, 1990, Cintichem reported identification of iodine-131 (I-131) and sodium-24 (Na-24) in an onsite retention pond that collects runoff from the storm drain system. The NRC and New York State dispatched teams to the site (NRC licenses operation of the 5Mw reactor and use of special nuclear material; the State of New York licenses the possession and use of byproduct materials in hot cells and related facilities adjacent to the reactor). Until February 20, the NRC and New York State believed that no releases of radioactively contaminated water to the nearby Indian Kill Reservoir had occurred. However, on February 20, the licensee indicated that, prior to completing the analysis of water samples from the retention pond early on February 9, the onsite retention pond was drained to the reservoir several times due to runoff from heavy rainfall. The retention pond was later determined to have had I-131 slightly in excess of the NRC limits for releases to unrestricted area. The State of New York subsequently measured I-131 in the reservoir, but at levels less than the EPA's standards for drinking water. While there was no effect on public health or safety, the event is of particular interest because: (1) the reservoir serves as a drinking water source for about 150 families in the Tuxedo, NY area; and (2) the plant is one of the nation's largest manufacturers of radioisotopes for medical purposes. The details of the event are as follows:

The licensee irradiated uranium oxide targets in its pool-type reactor. The target material was transferred through a water-filled canal to a storage pool (called a gamma pit) below the hot cells. After being placed in the hot cells, a variety of radioisotopes produced in the irradiation process were separated, refined and shipped for use with various radio-pharmaceuticals to diagnose and treat a number of medical conditions.

On December 12, 1989, NRC Region I received notification that the licensee, through its routine sampling program, had identified a possible discharge of slightly contaminated water in a storm drain in the onsite parking lot. However, samples from a number of surface and groundwater locations on site revealed no additional measurable contamination and no obvious source of the contamination in the storm drain water. In particular, an onsite

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retention pond which received water from the storm drain system (and which itself drained to the Indian Kill Reservoir) showed no detectable contamination. The NRC monitored the licensee's actions to identify the source of the radioactivity, and on January 5, 1990, following the latest in a series of cyclic changes in the amount of radioactivity in the storm drain, NRC Region I instructed the licensee to release no water from the retention pond to the reservoir prior to sampling and analyzing the samples to ensure that no measurable release to the reservoir occurred. Until February 9, 1990, no measurable activity was observed in the retention pond. On February 9, 1990, Cintichem reported to Region I the identification of several radioisotopes in the retention pond. All but one were at concentrations that could be released to unrestricted areas. However, I-131 was present at nearly twice the maximum permissible concentration (MPC) permitted for such releases. Following the discovery of radioactivity in the retention pond on February 9, 1990, all discharges to the reservoir were halted. The licensee began pumping the contents of the retention pond to onsite holding tanks and additional tanks were brought on site. The licensee processed this water to remove the radioactivity and transferred it to another tank for sampling and analysis prior to discharge downstream of the reservoir.

Between February 9 and 16, 1990, a team of specialists monitored the licensee's corrective actions, confirmed that the reactor had been shut down, confirmed the licensee's measurements of radionuclides in water, and assured that, after its arrival on site, all liquid releases met regulatory limits. The team also monitored the licensee's actions to identify the source of the contamination leaks. A concrete wall in a portion of the gamma pit was identified as a source of the leak to the retention pond. A leak was also identified in a part of the reactor coolant system called the hold-up tank.

On February 13, 1990, an NRC Order was issued to Cintichem requiring submission of a plan of short and long term actions to correct current and prevent future leaks.

Subsequently, on February 20, 1990, the licensee informed the NRC that several discharges, contaminated with I-131 at about twice the appropriate MPC and with several other radioisotopes at concentrations less than MPC, were made from the retention pond to the reservoir on February 9, 1990. Subsequent to this notification, the NRC issued Confirmatory Action Letter (CAL) No. 1-90-005 on February 23, 1990, which confirmed the licensee's commitment to (1) stop all intentional releases of water from the onsite retention pond to the reservoir, (2) eliminate leakage/seepage from the retention pond to the reservoir through the discharge pipe, (3) divert all discharges from the retention pond to a discharge point in the creek downstream of the reservoir, but only after sampling and analyses to assure the radioactivity is below applicable maximum permissible concentrations, and (4) immediately notify the NRC Region I Office if radioactivity is measured in the retention pond above background levels or if any unmeasured releases occur. Subsequent to receipt of this CAL, the licensee notified the Region I Office on the evening of February 23, 1990, that elevated levels of radioactivity (although less than the appropriate MPCs) were found in the retention pond and that, due to heavy rainfall during the day, the retention pond had to be discharged to the stream prior to completion of analyses, in order to protect the integrity of the retention pond. These releases were made in accordance with the CAL.

On March 5, 1990, in response to the February 13, 1990 NRC Order, the licensee submitted a plan for locating and repairing all leaks, and verifying the effectiveness of the repairs. Implementation of this plan would include various tests of the integrity of the reactor pool system, repair all identified leaks, retest of all systems for water leakage, and development and installation of a monitoring system or program for the early detection of leaks in the reactor pool system. As a result of the reactor shutdown, no new production of radioisotopes was occurring.

NRC representatives, along with representatives of the New York State agencies responsible for regulating activities at Cintichem involving radioactive material, met with local officials and members of the public on several occasions to inform them of the situation at Cintichem. Both regulatory bodies agree that the releases to the reservoir, though undesirable, did not represent a hazard to public health and safety.

After the licensee had indicated that he would be decommissioning the reactor and the hot cells a meeting was held on April 11, 1990, involving NRR, NMSS, Region I, New York State, and the licensee to discuss (1) development and funding of a decommissioning plan, (2) development of a plan to repair and use the transfer canal and gamma pit for removal of fuel, and (3) current actions under present licenses to remove loose radioactive material.

Cintichem Incorporated
Cintichem Nuclear Reactor
5 MW

1. GENERAL

1.1 Reactor Name (Acronym) .... Cintichem Nuclear Reactor (CNR)
1.2 License Number R-81
1.3 NRC Docket Number 50-54
1.4 Reactor Address .... Cintichem Incorporated
P.O. Box 816
Tuxedo, New York 10987-0816 U.S.A.
1.5 Reactor Telephone .... (914) 351-2131
1.6 Reactor Telex .... (710) 577-2881
1.7 Reactor Owner .... Cintichem Incorporated
1.8 Reactor Operator .... Cintichem Incorporated
1.9 Reactor Administrators .... William G. Ruzicka, Nuclear Operations Manager
Michael D. Johnson, Reactor Supervisor
Robert A. Strack, Reactor Project Engineer
1.10 Reactor Facility Staff
- a. Scientific/Technical
- b. Operations 4
- c. Support 12
- d. Normal Number of Personnel in Reactor Containment/Confinement 5

12 daytime/2 backshifts

1.11 Operations Staff Annual Salary Range
- a. Chief Reactor Operator (Operations Supervisor) $29,700–44,500
- b. Shift Supervisor
- c. Senior Reactor Operator $25,500–38,200
- d. Reactor Operator $25,500–38,200

$22,000–33,000

1.12 Reactor Architect/Engineer .... AMF Atomics
White Plains, New York
1.13 Reactor Constructor .... AMF Atomics
White Plains, New York
1.14 Organization/Country Supplying Nuclear Technology .... U.S.A.
1.15 Reactor Setting .... Industrial facility. Wooded, mountainous terrain. Low population density in immediate vicinity. Located within 50 mile radius of New York City.
1.16 Reactor Operating Status
- a. Initial Criticality Date .... September 8, 1961
- b. Full Power Date .... December 19, 1961
- c. Operating Cycle .... 14 day cycle (continuous operation except for 8–10 hours to refuel)
- d. Full Power Hours/Year
- e. Pulses/Year, Average Energy 7,800

1.17 Reactor Facility Cost .... Not applicable
1.18 Annual Operating Budget $2,447,000
1.19 Facility Insurance .... Not provided
- a. Coverage
- b. Annual Premium .... Not provided

Not provided

2. REACTOR

2.1 Reactor Type .... Open pool, light water moderated, plate fuel. Research reactor.
2.2 Reactor Vessel
- a. Configuration .... Open pool
- b. Overall Dimensions .... Pool end: 20.0 ft (6.1 m) × 20.0 ft (6.1 m) × 30.0 ft (9.15 m) high. Stall end: 14.0 ft (4.27 m) × 17.0 ft (5.19 m) × 15.0 ft (4.58 m) high over 7.0 ft (2.13 m) × 17.0 ft (5.19 m) × 15.0 ft (4.58 m) high.

c. Material .... Magnetite and ordinary concrete.
d. Normal Operating Pressure .... 10.8 psig (0. 5 bar)
e. Normal Operating Temperature .... 100°F (38°C)

2.3 Core
a. Volume .... 6.0 ft³ (171.6 l)
b. Overall Dimensions .... 1.5 ft (0.46 m) × 2.0 ft (0.61 m) × 2.0 ft (0.61 m) high.
c. Lattice Configuration .... Grid: 9 elements wide × 6 elements long.
d. Number of Elements
1. Standard 31
2. Control 6
e. Maximum Number of Grid Locations that can be used for Fuel 50
f. Subdivided Core
1. Number of Subdivisions .... None
2. Subdivision Differentiating Characteristics .... Not applicable
3. Number of Elements per Subdivision .... Not applicable

2.4 Containment
a. Type .... Confinement building
b. Volume .... 2.85 × 10⁵ ft³ (8 094 m³)
c. Material .... Reinforced concrete

2.5 Moderator .... Light water

2.6 Blanket Gas .... None

2.7 Reflectors .... Graphite thermal column imbedded in east pool wall, 4.0 ft (1.22 m) × 4.0 ft (1.22 m) extending 11.0 ft (3.36 m) from the core face.

2.8 Thermal Shield .... None

2.9 Biological Shield .... 6.0 ft (1.83 m) of magnetite concrete pool walls.
a. External Radiation Levels .... Less than 1 mrem/hr through pool walls. Less than 15 mrem/hr at pool surface.

2.10 Power Level
a. Normal Steady State .... 5 MW
b. Pulsing .... Not applicable

2.11 Normal Average Thermal Power Density
a. Volumetric .... 833.3 KW/ft³ (29.4 KW/l)
(2.10.a/2.3.a)
b. Linear .... 4.5 KW/ft (14.76 KW/m)
(2.10.a/(Number of Plates/Pins × Plate/Pin Length))

2.12 Normal Specific Power .... 453.72 KW/lb (1,000 KW/kg) U-235
(2.10.a/5.1.b)

2.13 Reactor Control
a. Safety Rods
1. Number 5
2. Shape and Dimensions .... Hollow rectangle with corners machined to a semicircle. 0.85 in (2.16 cm) × 2.23 in (5.66 cm) × 24.5 in (62.23 cm) long.
3. Material and Loading .... Silver, indium, cadmium.
4. Normal Withdrawal/Insertion Speed .... 5.0 in/min (12.7 cm/min)
5. Scram Insertion Speed .... 32.0 in/sec (31.23 cm/sec) average
6. Total Reactivity .... 0.12 Delta K/K
7. Normal Average Reactivity Addition Rate .... 0.0048 Delta K/K/min
8. Scram Mechanism ... Safety rod magnet current interrupt at [illegible] % power, 3 second period, or low core flow.
b. Pulse Rods
1. Number .... None
2. Shape and Dimensions .... Not applicable
3. Material and Loading .... Not applicable
4. Normal Withdrawal/Insertion Speed .... Not applicable
5. Scram Insertion Speed .... Not applicable
6. Total Reactivity .... Not applicable
7. Normal Average Reactivity Addition Rate .... Not applicable

8. Scram Mechanism .... Not applicable

c. Regulating Rods

1. Number 1
2. Shape and Dimensions .... Rectangle with corners machined to a semi-circle. 0.85 in (2.16 cm) × 2.23 in (5.66 cm) × 24.5 in (62.23 cm) long.
3. Material and Loading .... Stainless steel
4. Normal Withdrawal/Insertion Speed .... 24.0 in/min (60.96 cm/min)
5. Total Reactivity .... 0.0029 Delta K/K
6. Normal Average Reactivity Addition Rate .... 0.0029 Delta K/K/min
7. Scram Mechanism .... None

d. Chemical Shim Control

1. Chemical .... None
2. Loading .... Not applicable
3. Control Mechanism .... Not applicable
4. Total Reactivity .... Not applicable

e. Burnable Poison

1. Isotopes Utilized .... None
2. Location .... Not applicable
3. Loading .... Not applicable
4. Total Reactivity .... Not applicable

3. FUEL

3.1 Standard Fuel Element

a. Configuration .... 18 curved plates, 16 fueled with a total of 0.43 lb (0.196 kg) U-235.

b. Element Dimensions .... 3.0 in (7.62 cm) × 3.14 in (7.98 cm) × 34.38 in (87.31 cm) long.

c. Overall Plate/Pin Dimensions .... 2.8 in (7.11 cm) × 0.05 in (0.13 cm) × 24.63 in (62.55 cm), before forming curve of 6.5 in (16.51 cm) radius.

d. Number of Plates/Pins per Element 18

e. Distance Between Plate/Pin Centerlines .... 0.16 in (0.42 cm)

f. Active Portion of Fuel Plate/Pin

1. Dimensions .... 2.5 in (6.35 cm) × 0.02 in (0.51 cm) × 23.5 in (59.7 cm).
2. Composition .... Uranium-aluminum alloy or powder metallurgy.
3. U-235 Enrichment 93%
4. Fissile Material Density .... 0.023 lb/in^3 (0.64 gm/cc) U-235

g. Reflector Portion of Fuel Plate/Pin

1. Composition .... None
2. Dimensions .... Not applicable

h. Clad

1. Composition .... 1100 aluminum or AG3NE (equivalent to 5052 aluminum)
2. Thickness .... 0.015 in (0.038 cm)

i. Side Plate

1. Composition .... 6061 T6 aluminum
2. Thickness .... 0.19 in (0.48 cm)

j. Structural Material .... 6061 T6 aluminum

3.2 Control Rod Fuel Element

a. *Specify Differences from Standard Fuel Elements* . 9 plates, all fueled. 1.25 in (3.18 cm) × 2.32 in (5.89 cm) central control rod slot.

3.3 Fuel Cycle

a. Criteria for Refueling .... Insufficient reactivity for peak Xenon startup.

b. Frequency of Refueling .... 1 element/12 days

c. Normal Element Lifetime .... 55 MW-days

d. Burnup

1. Average U-235 Burnup .... 40–45 wt%
2. Peak U-235 Burnup .... 50 wt%
3. Maximum Allowed U-235 Burnup .... 1.31 × 10^{22} fissions/in^3 (8.0 × 10^{20} fissions/cc)

e. Number of Elements Replaced During Typical Refueling 2

f. Spent Fuel
 1. Minimum Cooling Time .... 90 days
 2. Maximum Amount in Storage .... Licence limitation of 88 lb (40 kg) U-235 (irradiated).
g. Disposition of Spent Fuel .... Shipped for reprocessing to Savannah River Lab Aiken, South Carolina
h. Spent Fuel Shipping Cask .... BMI-1 Cask (owned by Cintichem)
i. Spent Fuel Handling .... Pool racks for temporary storage. Transferred under water into shipping cask.
j. Fuel Failure Detection .... Pool water isotopic analysis. Pool surface air particulate monitor. Ventilation system radiation monitor.

3.4 Fuel Inventory
 a. Current Fissile Material Inventory Status
 1. New Fuel In-Process .... 22 standard elements, 6 control elements
 2. New Fuel On Hand .... 25 standard, 12 control
 3. Fuel In-Core .... 31 standard, 3 control
 4. Spent Fuel In Storage .... Approximately 7.49 lb (3.4 kg) U-235
 5. Spent Fuel Being Reprocessed .... None
 6. Non-fuel Special Nuclear Material .... Not provided
 b. Fissile Material Inventory Needed to Assure Continuity of Operations
 1. New Fuel In-Process .... 22 standard, 6 control
 2. New Fuel On Hand .... 25 standard, 12 control
 3. Fuel In-Core .... 31 standard, 6 control

3.5 Fuel Source
 a. Fuel Fabricator .... CERCA Romans, France
 b. Fuel Supplier .... U.S. Department of Energy
 c. Fissile Material Origin .... U.S.A.
 d. Enrichment Supplier .... U.S. Department of Energy
 e. Method of Fabrication .... Uranium-aluminum powder compressed and sintered, hot rolled in aluminum clad and swaged into aluminum side plates.
 f. Fuel Element Cost .... $6,000 (delivered)

4. HEAT TRANSFER DATA

4.1 Fuel Element Heat Transfer Area .... 473.12 ft² (44.0 m²)
(Number of Plates/Pins × Active Plate/Pin Surface in Contact with Coolant)

4.2 Fuel Element Flow Area .... 1.24 ft² (0.12 m²)

4.3 Fuel Element Wetted Perimeter .... 7.92 ft (2.42 m)

4.4 Fuel Meat Thermal Resistivity .... 98 BTU/hr-ft-°F (170 W/m-°C)

4.5 Clad-Coolant Heat Transfer Coefficient (at Hot Spot) .... 1,461 BTU/hr-ft²-°F (8,300 W/m²-°C)

4.6 Heat Flux at Plate Surface
 a. Normal Average Heat Flux .... 3.59×10^4 BTU/hr-ft² (1.13×10^5 W/m²)
 b. Peak Heat Flux
 1. Without Hot Channel Factors .... 1.11×10^5 BTU/hr-ft² (3.5×10^5 W/m²)
 2. With Hot Channel Factors .... 1.18×10^5 BTU/hr-ft² (3.73×10^5 W/m²)
 c. Axial Peaking Factor in Hot Channel (from Axial Fission Rate Distribution)
 1. Without Hot Channel Factors 1.3
 2. With Hot Channel Factors 1.39
 d. Hot Spot Location .... Variable

4.7 Peak Operating Fuel Plate/Pin Temperature
 a. At Plate/Pin Surface
 1. Without Hot Channel Factors .... 154°F (67.8°C)
 2. With Hot Channel Factors .... Not provided
 b. Inside Fuel Meat
 1. Without Hot Channel Factors .... 156°F (68.9°C)
 2. With Hot Channel Factors .... Not provided

4.8 Primary Coolant ... Light water

4.9 Coolant Flow
- a. Flow Direction ... Vertically downward through core.
- b. Flow Induced By ... 60 HP centrifugal pump and gravity.
- c. Normal Flow Rate ... 2,200 gpm (8,338 l/min)
- d. Maximum Flow Rate ... 2,4?0 gpm (9,286 l/min)
- e. Mean Core Flow Velocity ... 3.9 ft/sec (1.19 m/sec)
- f. Normal Core Inlet Temperature ... 100°F (38.08°C)
- g. Normal Core Temperature Rise ... 15°F (8.4°C)
- h. Peak Coolant Temperature Rise at Hot Spot
  1. Without Hot Channel Factors ... 22°F (12.32°C)
  2. With Hot Channel Factors ... 26°F (14.56°C)
- i. Coolant Pressure at Core Outlet ... 8.4 psig (0.58 bar)
- j. Coolant Pressure at Hot Spot
  1. Without Hot Channel Factors ... 8.8 psig (0.61 bar)
  2. With Hot Channel Factors ... Not provided

4.10 Hot Channel Factors (Including Only Effects Other than Nuclear Peaking; Specify Breakdowns)
- a. For Coolant Temperature Rise ... 1.66
- b. For Film Temperature Rise ... 3.4
- c. Others ... None

4.11 Core Heat Dissipation System ... Primary-secondary heat exchanger. Cooling tower for secondary coolant.

4.12 Shutdown Heat Removal System ... Natural convection
- a. Worst Case Elapsed Time from Shutdown to Coolant Independence Without Fuel Distortion ... 0.0 min

4.13 Emergency Core Cooling System ... Core spray nozzle directed toward the reactor core.

5. NUCLEAR DATA

5.1 Fuel Loading
- a. Minimum Critical Mass ... 7.61 lb (3.45 kg) U-235
- b. Normal Core Loading ... 11.02 lb (5.0 kg) U-235
  (Beginning of Cycle at Rated Power)
- c. Maximum K_{excess} Components
  1. Temperature ... 0.0044 Delta K/K
  2. Equilibrium Xenon ... 0.034 Delta K/K
  3. Equilibrium Samarium ... 0.0095 Delta K/K
  4. Xenon Override ... 0.073 Delta K/K
  5. Burnup (Including Burnable Poison) ... 0.0076 Delta K/K (10 days)
  6. Experimental Sample ... 0.02 Delta K/K
  7. Others ... Control and beam tubes: 0.021 Delta K/K.
  8. Total ... 0.14 Delta K/K
- d. Shutdown Margin ... 0.005 Delta K/K with the most reactive control rod fully withdrawn.

5.2 Reactivity Coefficients
- a. Temperature
  1. Moderator ... -4.4×10^{-4} Delta K/K/°F (-7.92×10^{-4} Delta K/K/°C)
  2. Doppler ... Not applicable
  3. Fuel Expansion ... Not applicable
  4. Burnable Poison ... Not applicable
- b. Void ... -2.7 to -4.4×10^{-3} Delta K/K/% void

5.3 Neutron Flux Densities
- a. Steady State Average Thermal ... 3.5×10^{13} n/cm²/sec
- b. Steady State Peak Thermal ... 1.0×10^{14} n/cm²/sec
- c. Steady State Average Fast ... 1.0×10^{13} n/cm²/sec
- d. Steady State Peak Fast ... 3.0×10^{13} n/cm²/sec
- e. Peak Pulsing Power ... Not applicable
- f. Pulse Integrated Power ... Not applicable

5.4 Pulsing Characteristics
- a. Pulse Period .... Not applicable
- b. Full Width at Half Maximum .... Not applicable
- c. Maximum Frequency of Pulses .... Not applicable

5.5 Fission Density
- a. Normal Average .... 9.84×10^{21} fissions/in³ (6.0×10^{20} fissions/cc)
- b. Peak .... 1.31×10^{22} fissions/in³ (8.0×10^{20} fissions/cc)
- c. Axial Peak/Average Radio for Typical Element 1.2

5.6 Maximum Fission Product Inventory .... Approximately 1.0×10^{7} Ci

6. OPERATING EXPERIENCE

6.1 Forced Outages in the Past Five Years
- a. Equipment Malfunction 130
- b. Personnel Error 10
- c. Full power Operating Hours .... 40,000 MW - hr/yr

7. SAFEGUARDS

7.1 Agency Responsible for Regulatory Jurisdiction .... U.S. Nuclear Regulatory Commission

8. PAST MODIFICATIONS AND FUTURE PLANS

8.1 Past Major Modifications
- a. Power Increase/Date .... None
- b. Fuel Conversion/Date .... Uranium-aluminum (U-Al) alloy to Uranium aluminide powder metallurgy fuel/September 22, 1978
- c. Other/Date .... None

8.2 Future Major Modifications
- a. Power Increase/Date .... None planned
- b. Fuel Conversion/Date .... Evaluating low enriched fuel/Date not provided
- c. Decommissioning/Date .... Not planned
- d. Other/Date .... None planned

8.3 Future Reactors
- a. Type/Date .... None planned

9. REACTOR, LABORATORY, AND EXPERIMENTAL FACILITIES

9.1 Accelerators
- a. Description .... None

9.2 Beamports
- a. Description .... 2 horizontal beam tubes reaching core.
- b. Dimensions .... 4: 6.0 in (15.24 cm) diameter. 2: 8.0 in (20.32 cm) diameter.
- c. Thermal Neutron Flux .... 3.0×10^{13} n/cm²/sec
- d. Fast Neutron Flux .... 3.0×10^{13} n/cm²/sec
- e. Gamma Dose Rate .... Not provided

9.3 Converter Blocks
- a. Description .... None
- b. Dimensions .... Not applicable
- c. Thermal Neutron Flux .... Not applicable
- d. Fast Neutron Flux .... Not applicable
- e. Gamma Dose Rate .... Not applicable

9.4 Critical Assemblies
- a. Description .... None
- b. Dimensions .... Not applicable
- c. Thermal Neutron Flux .... Not applicable
- d. Fast Neutron Flux .... Not applicable
- e. Gamma Dose Rate .... Not applicable

9.5 Gamma Sources
- a. Description .... Cobalt (Co)–60
- b. Dimensions .... Not provided
- c. Gamma Dose Rate .... 2.0×10^4 rad/hr

9.6 Hot Cells
- a. Description .... 5 cells connected to one another by conveyor and to the reactor pool by a canal. Five additional cells.
- b. Dimensions .... 1: 10 ft (3.05 m) × 16.0 ft (4.88 m) × 15.0 ft (4.58 m) high. 4: 6.0 ft (1.83 m) × 10.0 ft (3.05 m) × 12.0 ft (3.66 m) high.

9.7 Irradiation Racks
- a. Description .... None
- b. Dimensions .... Not applicable
- c. Thermal Neutron Flux .... Not applicable
- d. Fast Neutron Flux .... Not applicable
- e. Gamma Dose Rate .... Not applicable

9.8 Neutron Activation Analysis
- a. Description .... Available

9.9 Neutron Generator
- a. Description .... Kaman Nuclear, 14 MeV, model CC711
- b. Thermal Neutron Flux .... Not provided
- c. Fast Neutron Flux .... Not provided

9.10 Neutron Radiography
- a. Description .... None

9.11 Neutron Sources
- a. Description .... None
- b. Dimensions .... Not applicable
- c. Thermal Neutron Flux .... Not applicable
- d. Fast Neutron Flux .... Not applicable

9.12 Neutron Spectrometer
- a. Description .... None

9.13 Pneumatic Tubes
- a. Description .... 3 pneumatic rabbit tubes.
- b. Dimensions .... 2: 0.6 in (1.52 cm) diameter. 1: 1.5 in (3.81 cm) diameter.
- c. Thermal Neutron Flux .... 3.0×10^{13} n/cm²/sec
- d. Fast Neutron Flux .... 1.0×10^{13} n/cm²/sec
- e. Gamma Dose Rate .... Not provided

9.14 Radioisotope Laboratories
- a. Description .... 10,000 ft² (930 m²) building, connected to reactor building houses hot cells, radiochemical labs, offices, target preparation areas and shipping area.

9.15 Reactor Core
- a. Description .... Central and peripheral irradiation locations.
- b. Dimensions .... Central: 3.0 (7.62 cm) × 3.0 in (7.62 cm). Peripheral: 18.0 in (45.72 cm) wide extending 24.0 in (60.96 cm) from core.
- c. Thermal Neutron Flux .... Central: 3.0×10^{13} n/cm²/sec. Peripheral: 1.0×10^{13} n/cm²/sec.
- d. Fast Neutron Flux .... Central: 1.0×10^{13} n/cm²/sec. Peripheral: 3.0×10^{13} n/cm²/sec.
- e. Gamma Dose Rate .... Not provided

9.16 Reactor Pool
- a. Description .... Spent fuel elements

b. Dimensions .... Variable
c. Thermal Neutron Flux .... Negligible
d. Fast Neutron Flux .... Negligible
e. Gamma Dose Rate .... 6.0×10^4 rad/hr

9.17 Thermal Column
a. Description .... Horizontal and vertical access column.
b. Dimensions .... 4.0 ft (1.22 m) × 4.0 ft (1.22 m).
c. Thermal Neutron Flux .... 2.0×10^{11} n/cm²/sec
d. Fast Neutron Flux .... 3.0×10^4 n/cm²/sec
e. Gamma Dose Rate .... Not provided

10. RESEARCH AND TECHNICAL PROGRAM AND REACTOR UTILIZATION SUMMARY

10.1 Research, Technical, and Training Program

The Cintichem Nuclear Reactor initially was used for metal product research, activation analysis, medical product research and numerous other research programs. A business emerged making the Cintichem Reactor a major supplier of medical radioisotopes. At the reactor and hot lab facilities targets are prepared for irradiation and processed after irradiation. The separated isotopes are distributed world-wide.

10.2 Principal Isotopes Produced .... Phosphorous (P)–32, molybdenum (Mo)–99/technecium (Tc)-99, tin (Sn)–113, iodine (I)–125, iodine (I)–131, and xenon (Xe)–133.

11. COMPUTER CODES UTILIZED IN DESIGN

11.1 Neutronics .... None

11.2 Structural Design
a. Reactor Vessel .... None
b. Fuel .... None
c. Containment .... None

11.3 Heat Transfer .... None

12. FACILITY DESIGN AND OPERATION REFERENCE DOCUMENTS

Final Hazards Summary Report - UCNR Research Reactor; June 17, 1957.
Supplementary Information to Final Hazards Summary Report - UCNR Research Reactor; April 28, 1961.
Supplement 2 to Final Hazards Summary Report; June 21, 1977.
CNR Technical Specifications, Appendix A to License R–81; May 17, 1979.
USNRC NUREG-1059 Safety Evaluation Report; June, 1984.

2 SITE CHARACTERISTICS

2.1 Site Description

Cintichem, Inc.

The ~~Union Carbide Subsidiary B Inc~~., Medical Products Division, nuclear reactor facility is located within the city of Tuxedo, in Orange County, New York. Orange County, in southeastern New York State, is bordered on the south by New Jersey and is approximately 40 mi northwest of New York City. Tuxedo, in the extreme southeastern corner of Orange County, is approximately 4 mi north of the New Jersey state line. The plant site is located on 100 acres of land, owned by Union Carbide. It is in an industrial park area known as Sterling Forest and is about 3-1/4 mi northwest of the village of Tuxedo Park. Figure 2.1 is a map of the area surrounding the site. The plant itself, constructed along Long Meadow Road on the eastern slope of Hogback Mountain, is at an average elevation of 800 ft above mean sea level (MSL). A layout of the UCS complex is shown in Figure 2.2. Amdt. 23 7/2/8?

The five principal buildings at the plant site are

Building 1	Reactor
Building 2	Hot Laboratory (structurally joined to the reactor building)
Building 3	Maintenance
Building 4	Administration
Building 5	Heating Plant

There is also a small concrete block structure at the north end of the plant site used for temporary storage of drummed, miscellaneous low-level radioactive wastes.

2.2 Geography

The UCS reactor site is within a 22,000-acre woodland area called Sterling Forest, which is owned by a private development company. Sterling Forest contains three residential areas, several small research centers, the UCS facility, and a conference center. These developed areas make up a total of less than 1,500 acres. The remainder of the land is undeveloped. Adjoining Sterling Forest to the east is another large undeveloped area that is a part of the Palisades Interstate Park System. This 75,000-acre woodland contains approximately 31 summer camps, but essentially no year-round residents.

The approximately 20,500-acre undeveloped portion of Sterling Forest is managed ecologically by the Sterling Forest Development Corporation. This organization permits regulated (license and bag-limit) hunting in designated, marked portions of the area.

Regulated fishing also is permitted in designated lakes on the property. The Sterling Forest Development Corporation employs regulated lumbering, the main objective of which is to remove dead and disease-infested trees and promote maintenance of healthy understory.

Figure 2.1 10-mile radius map of site

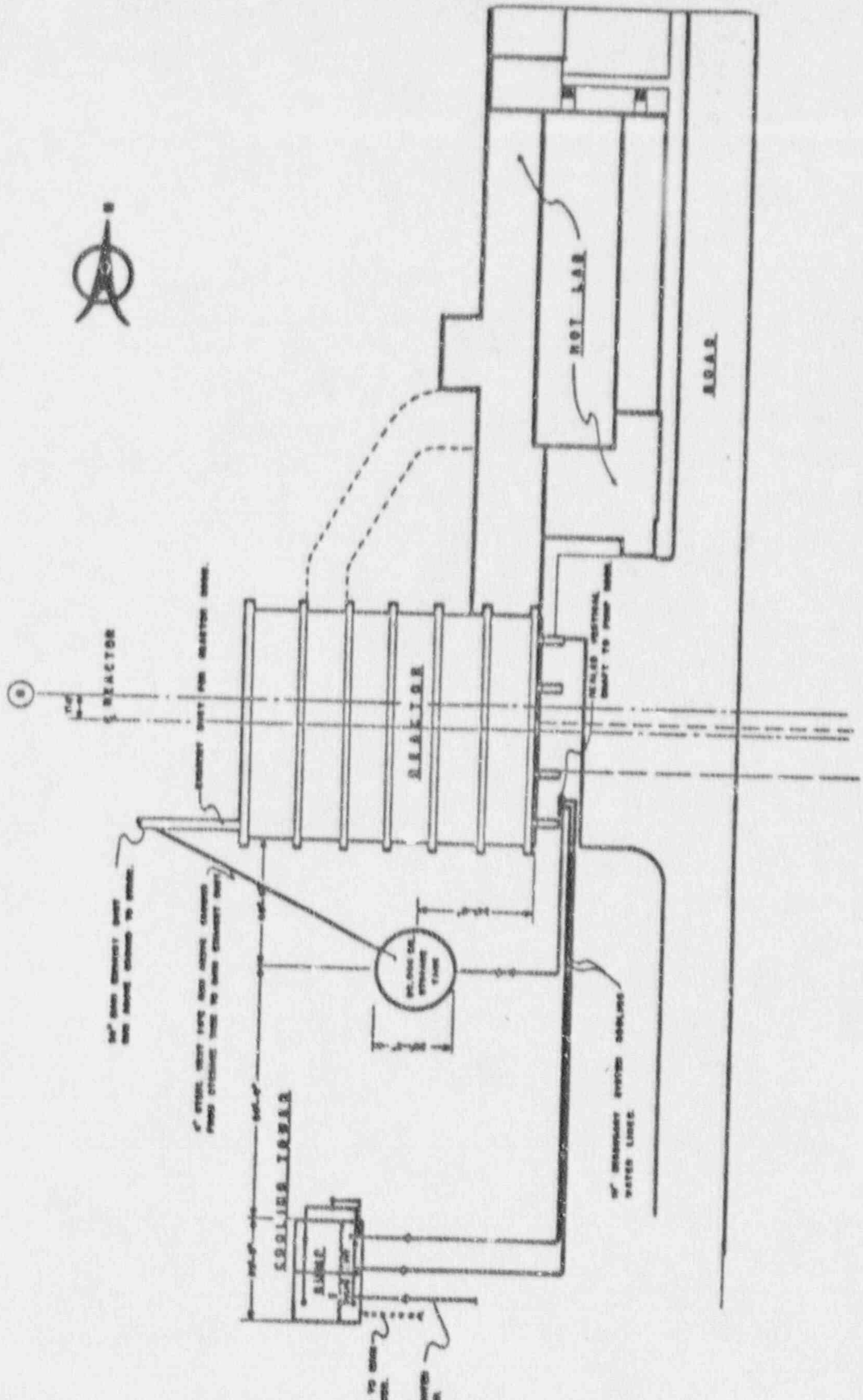

Figure 2.2 Reactor building-site plan

2.3 Topography and Surface Drainage

The reactor site is about 1,500 ft southwest of Indian Kill Brook, a small stream flowing southeast for a mile and a half to the Ramapo River. The plant borders Long Meadow Road at an elevation of approximately 800 ft.

There is a very low north-south topographic divide between Indian Kill Brook drainage and drainage of Warwick Brook to the south, which also flows east to the Ramapo River. These two small streams (Indian Kill Brook and Warwick Brook) drain into the Ramapo River from the vicinity of the site and thus dominate the surface drainage pattern away from the site.

Although the relief in the area is only 400 to 700 ft from valley floors to ridge tops, the hillsides are considered to be steep and rugged. From a past era of glaciation, the area features clogged drainage systems such as swamps, ponds, and lakes along stream channels. Fill, clay, sand, gravel, and boulders of every size also strew the hillsides. The reactor building is located at the eastern toe of the north trending spur of Hogback Mountain, which slopes from an elevation over 1,500 ft down to the level of Indian Kill Lake at an elevation of 700 ft.

As stated above, surface drainage from the site is exclusively by way of Indian Kill Brook. Indian Kill Brook enters the Ramapo River 1-1/2 mi east of the plant at el 463 ft. Tuxedo Lake stands at el 560 ft. Wee Wah, the adjoining lake to the north, stands lower than Tuxedo Lake to which it is joined by a small stream of high gradient. Wee Wah Lake consists of two segments. The southern, higher segment is separated from the northern, lower segment by a stream of steep gradient. This northern segment, in turn, discharges over an earth dam and masonry spillway to a small stream that discharges into Ramapo River. Thus, if Indian Kill Brook were contaminated as a result of some incident, contamination of this chain of three lakes by surface flow from the plant would not be possible.

2.4 Demography

The UCS plant is located in a thinly populated area. The closest occupied offsite area is the Laurel Ridge housing development which contains 132 houses at a minimum distance of 1,100 ft east of the reactor building. A second development, consisting of 27 houses in an area called Clinton Woods, is located 3,200 ft to the north. There are no other housing developments within 1.5 mi of the reactor.

Table 2.1 shows the population distribution in 22.5° compass sectors out to 50 mi. The north sector is centered on true north but includes 11°15' on either side of true north, a total of 22.5°. Likewise, all other sectors embrace an arc of 22.5°. The table indicates the most heavily populated areas to be to the southeast, south-southeast, and south of the site within the 20 to 50 mi radii. The high population density of these sectors is a result of the large metropolitan centers, e.g., New York City, Newark, and Bayonne.

Table 2.1 Population density around the Union Carbide reactor by 16 compass sectors out to 50 miles*

Sector	Miles					
	0 - 5	5 - 10	10 - 20	20 - 30	30 - 40	40 - 50
N	614	16,851	36,264	29,237	23,692	19,458
NNE	346	1,903	12,958	53,101	104,808	48,873
NE	108	1,081	14,135	26,503	31,023	26,850
ENE	187	10,489	47,176	43,204	50,442	183,112
E	107	17,330	61,749	30,032	76,475	84,156
ESE	330	7,481	15,506	49,112	275,267	127,105
SE	132	18,868	72,622	476,642	132,749	1,753,651
SSE	3,878	11,829	142,070	454,282	2,296,153	2,334,641
S	91	10,892	96,848	499,486	971,105	2,611,407
SSW	43	10,393	42,750	124,960	133,923	133,281
SW	0	2,951	18,238	60,235	97,985	45,567
WSW	125	2,834	27,381	20,741	30,893	35,991
W	68	23,192	10,754	19,855	13,179	7,900
WNW	878	2,195	8,022	21,651	8,775	7,443
NW	192	2,196	28,510	8,858	6,016	17,724
NNW	190	2,108	18,339	8,964	18,853	7,908

*Population estimates based on 1980 Census of Population and Housing.

2.5 Nearby Industrial, Transportation, and Military Facilities

As stated earlier, UCS is located about 3 1/4 mi from Tuxedo Park, New York, in an industrial park. Other tenants in the industrial park are light industry. The closest major highway or railroad is about 1.5 miles from the plant.

The closest military installation is West Point, about 10 mi from UCS. There are no commercial airports closer than 40 mi from the plant and the nearest private airport is 5.2 mi from the UCS plant. Stewart Airport, both a commercial and military airport, is located approximately 16 mi away on the outskirts of Newburgh, New York.

As none of the above industrial transportation, or military activities occur close to the reactor, the staff concludes that these activities pose no threat to the safe operation of the UCS reactor.

2.6 Meteorology and Climatology

The climate of the Sterling Forest area is predominantly influenced by air mass movements and prevailing winds from an inland direction. Cold frontal weather moves across the area from west to east at average velocities of 30 to 35 mph in winter and considerably more slowly in summer. This is a part of the normal cyclonic circulation in which high- and low-pressure systems follow paths toward the northeastern United States. About 40% of the low centers pass over or close to southeastern New York so that there is regular change in weather patterns without any consistent periods of stagnation.

Centers of high pressure alternate more or less regularly with the lows. In the wintertime, their movement is variable, depending on the strength of cold air outthrusts from the arctic area to the northwest. This movement is slowest during summer and early fall so that, with the prevailing westerlies aloft reaching their most northerly movement at the same time, high-pressure centers can become stationary for a few days during these seasons. During a 2-year period of inversion observation, only 21 inversions persisted for more than 12 hours and only 6 persisted longer than 24 hours.

Mean ambient air temperatures vary from 28°F (minus 1°C) in January, to 75°F (24°C) in July, with extremes of -19°F (-30°C) and 105°F (41°C). Precipitation is fairly uniform throughout the year with an average rainfall of about 44 in.

Dispersion values, χ/Q, from field sampling and measurements were obtained at various atmospheric monitoring points and from the reported annual releases of I-125 and I-131. These were used to compare against calculated concentrations of the particular isotopes at the corresponding points. In all cases, the predicted value exceeded the measured value. Additional calculations were performed to investigate the local topographical effects on the χ/Q values.

2.7 Geology

The UCS plant site is located within a seismogenic zone trending along the Ramapo Fault System. The Ramapo Fault System and other fault systems within the zone encompass the Manhattan Prong, Newark Basin, and the Hudson Highlands. They are made up of semiductile thrust and strike-slip faults of Precambrian and early Paleozoic age, and brittle faults with dip-slip and oblique sense of motion, generally of Mesozoic and younger age. The younger faults show evidence of long periods of recurrent movement. The seismogenic zone is approximately 30 km (18 mi) wide and is centered on the northeasterly striking, southeasterly dipping Ramapo Fault System. The hypocentral depths are from 0 to 10 km (6 mi) and the focal mechanisms indicate either reverse or right lateral strike-slip motion on the northeast striking faults.

On the basis of the available data from recent investigations and mapping of the Ramapo Fault System, there is no evidence of recent movement. Many of the investigations by the U.S. Geological Survey and by consultants for the Indian Point Nuclear Power Plant applicant were conducted for the specific purpose of determining the age of deformation in the vicinity of the Ramapo Fault System and whether or not there is evidence of geologically old fault activity. The staff concluded that the Ramapo Fault System should not be considered capable within the meaning of 10 CFR 100, Appendix A.

The plant is situated on a northerly trending spur of Hogback Mountain along Long Meadow Road. Bedrock is highly metamorphosed and consists of very dense, hard Precambrian granite gneiss that is fractured near the surface. Drill holes in the area produced nearly complete core recoveries and ground water was measured at a depth of 85 ft below the surface.

2.8 Hydrology

As stated in Section 2.3, the surface water features of significance in connection with the operation of the UCS reactor are the Indian Kill Reservoir, Indian Kill Brook, Warwick Brook, and the Ramapo River.

Surface drainage from the site is exclusively by way of Indian Kill Brook, but because of the unique surface hydrology, even if the Indian Kill Brook were contaminated, it is not remotely possible to carry such contamination by surface flow to any of this chain of three lakes (Section 2.3).

Indian Kill Brook presents the only obvious path for contamination by underground flow, that is, through alluvial sand, silts, and gravels that lie beneath the stream channel, resting on the gneissoid bedrock of the region. Water passes downstream easily but slowly through these alluvial deposits. Such waters could not possibly ascend into the chain of Tuxedo Lakes. Furthermore, it does not seem possible that water could pass underground beneath the mountainous ridges, through the fractures in the hard rocks. The mountainous tract, which is bounded by Indian Kill Brook, Long Meadow Road, Warwick Brook, and Ramapo River, naturally contains some ground water within fractures in the rocks. But this water drains outward to the nearest and most accessible exists, namely either Indian Kill Brook, Warwick Brook, or Ramapo River. Water cannot pass against this outward flow, across this mountainous tract, and even assuming it could, it could not pass the boundary of Warwick Brook, which flows east to Ramapo River. Therefore, the possibility of contamination of the Tuxedo Lakes chain by water from the vicinity of the plant may be dismissed. The only reasonable route for contaminated liquid effluents that might come from the plant site would be via Indian Kill Brook to the Ramapo River and thence to the Passaic River in New Jersey.

2.9 Seismology

Recent studies in New York State and adjacent areas have brought to light some of the geotectonic features that account for the seismicity in the region. Aggarwal and Sykes (1978) conclude that earthquakes occur predominantly along northeast trending faults of which the Ramapo fault is one such fault. However, in a more recent study (1983), Kafka concludes that earthquakes recorded from 1970 to 1982 by the microearthquake networks in the New York City metropolitan area do not corroborate evidence that northeast trending faults lying to the northwest of the Newark Basin (such as the Ramapo Fault) are any more active than those lying to the north and east of the basin. Woodward-Clyde Consultants (1982) report that earthquakes instrumentally located in the region do not lie preferentially along either the Ramapo Fault or along other northeast trending structures. No spatial correlation is observed between the distribution of epicenters and geologic structures or terranes that are mapped at the surface. The two largest events since the local seismic network has been operating in the New York metropolitan area were not associated with the Ramapo Fault but rather were located in the Coastal Plain east of the Newark Basin (Cheesequake, New Jersey) and in the Valley and Ridge Province north of the Newark Basin (Wappingers Falls, New York). Epicenter locations of magnitude 2 and larger earthquakes appear to be in the region surrounding the Newark Basin. Although the Ramapo Fault shows a spatial correlation with some of the earthquakes, fault plane solutions for many of these events indicate primarily thrust-type faulting on north-to-west striking planes, which is inconsistent with movement on the Ramapo Fault (Woodward-Clyde, 1982).

A relevant observation made by Kafka (1983) is that similarities between the distribution of seismicity of the recently (instrumentally) recorded earthquakes and the distribution of more than 200 years of historic earthquakes suggest that the seismic activity in this area has been relatively stationary over the last few hundred years.

The highest intensity reported for historic earthquakes in the area is Modified Mercalli Intensity (MMI) VII (1737, 1884). Kafka (1983) estimated the 1884 earthquake epicentral magnitude to be 4.9 (m_n). However, both the 1737 and 1884 earthquakes occured east of the Newark Basin and, as Kafka points out, the 1884 earthquake may have occurred offshore. There are, however, several earthquakes that occurred within the Ramapo Fault zone that have magnitudes estimated to be in the 4.7-4.8 range (Aggarwal and Sykes, 1978).

2.10 Conclusion

The staff has reviewed and evaluated the UCS reactor site and contiguous regions for natural and manmade hazards and concludes that there are no risks associated with the site that make it unacceptable for the continued operation of the reactor at the power level of 5 MW.

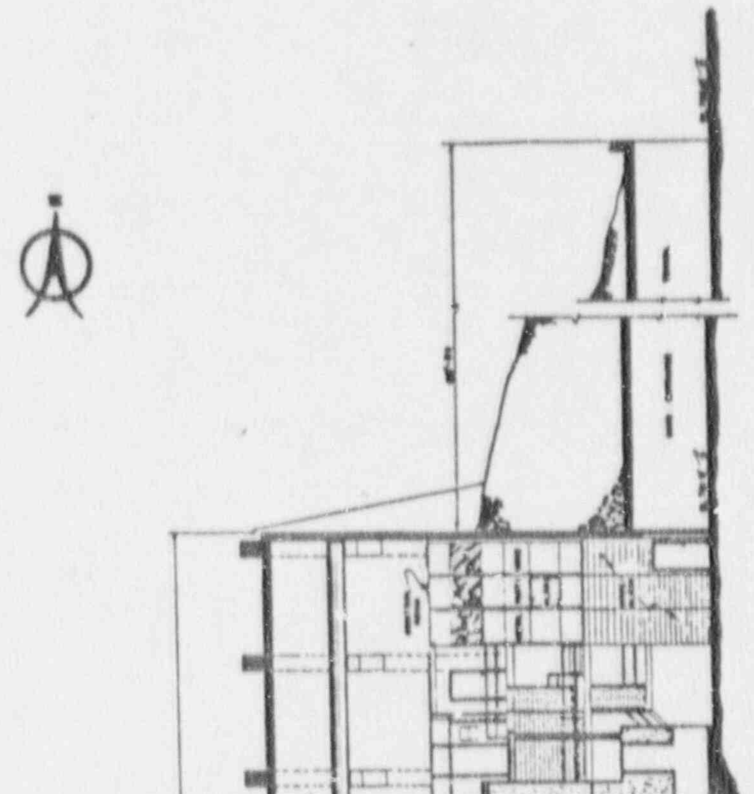

Figure 3.1 Reactor building elevation

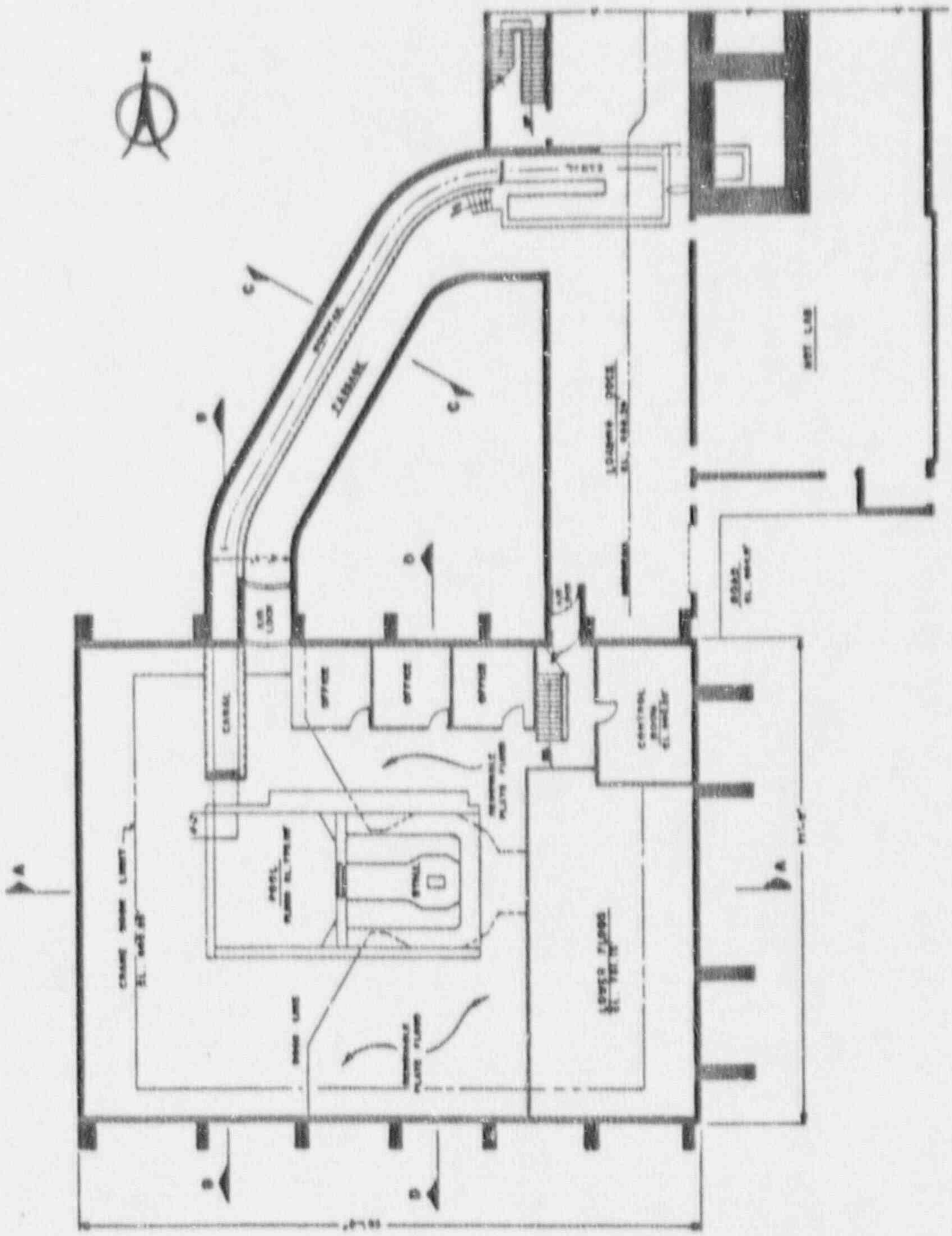

Figure 4.1 Reactor building at elevation 808.25 feet

From airport
G'State — 17 North Exit 165

17N to green sign that says
Ringwood / West Milford
3 miles down steep hill
rt onto Sterling Lake Rd at
first directory sign continue
to Cintichems (on left) several miles

samples were evaporated during preparation, any iodine present would have been driven off. The analytical method employed does not appear to be appropriate to determine the content of all radionuclides, including iodine in the process water. Use of an inadequate analytical method to determine the content of all radionuclides in water samples was identified as an apparent violation of T.S. 3.9.3.3 (54/89-80-12; 687/89-80-12). See Paragraph 10.2.

11.1.5 Analysis of the Reactor Pool Water

The licensee measures radioactivity of the reactor pool water to implement Sections 4.8.(2) and 4.8.(3) of Technical Specification requirements. The inspector reviewed the licensee's analytical procedure for the reactor pool water analysis. The reactor group supplies one gallon of pool water for analysis each month. The sample is held for one week before the analysis is performed. The gallon of pool water is then boiled down to 30 milliliters and counted for identification of the radioactive isotopes required by Section 4.8.(2) of the Technical Specifications. I addition, the licensee takes a daily grab sample (10 ml) of the reactor pool water to meet the Section 4.8.(3) requirement. That sample is boiled down to dryness on a planchet and measured for gross beta-gamma activity. The inspector stated that entrained noble gases, iodines, and any other volatile nuclides (if present) would be driven off by evaporation during sample preparation. In addition, the one-week delay prior to the analysis would allow all of the short-live nuclides to decay prior to analysis. Therefore, the inspector stated that the licensee's method for the analyses of the reactor pool water did not meet Technical Specification requirements since the analytical techniques used were not appropriate to identify all nuclides present. This was identified as apparent violation of Technical Specification 4.8.(2) and 4.8.(3) requirements (54/89-80-18).

One reactor pool water sample was analyzed in the NRC Mobile Laboratory in order to determine which radionuclides were present. Twenty milliliters of the reactor pool water were diluted to 50 milliliters and analyzed. Following are the NRC analytical results.

Nuclide	Reactor Pool Water Activity (uCi/ml)
Ar-41	(2.6 +/- 0.2)E-4
Xe-135	(1.25 +/- 0.04)E-4
Na-24	(6.67 +/- 0.03)E-3
I-131	(3.1 +/- 0.4)E-5
I-132	(1.12 +/- 0.12)E-4

B-2D

B-14

Licensee/Facility

Cintichem Incorporated
Tuxedo, New York
Dockets Nos. 70-687 and 50-54

Notification: 6/18/90

Subject: NYS-DEC Consent Order

REPORTABLE EVENT NUMBER:

On June 7, 1990, the State of New York, Department of Environmental Conservation (NYS-DEC) announced that Cintichem Incorporated was assessed a $200,000 penalty for violations of NYS-DEC requirements between October 1989 and February 1990. A consent order, signed by the company, was also issued on the same date. The violations stemmed from events at the facility which resulted in identification of radioactive leaks to onsite locations from the hot cell ventilation system and portions of the pool water system. The consent order calls for environmental and managerial audits, submission of an air emission permit application and the establishment of interim air emission limits, establishment of a groundwater monitoring program; development of a program for remediation of contamination released from the facility; and retention of contractor personnel to perform the technical engineering and analytical obligations required by the order. This consent order will substantially replace the commitments previously made by the licensee to the NRC in Confirmatory Action Letter No. 90-005 dated February 23, 1990. It does not affect the provisions of an NRC order issued on February 13, 1990 which required the licensee to shutdown the reactor and submit a plan for short term and long term actions to correct current and prevent future leaks.

The licensee subsequently announced on April 4, 1990, that the reactor and hot cell facilities will be shutdown permanently and decommissioned. The licensee is currently preparing a decommissioning plan which will be submitted to the NRC for approval.

Information concerning this announcement was received by the NRC from the NYS-DEC on June 15, 1990.

REGIONAL ACTION: Region I will follow-up.

Contact: R. Bores FTS: 346-5213