

50-267

ORISE
OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

March 21, 1996

Mr. David Fauver
U.S. Nuclear Regulatory Commission
Division of Waste Management - NMSS
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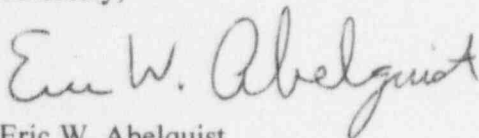
**SUBJECT: FINAL REPORT - ORISE SUPPORT OF NRC LICENSE INSPECTION AT
FORT ST. VRAIN ON SEPTEMBER 25 TO 27, 1995 (DOCKET NO. 50-267,
RFTA #95-30)**

Dear Mr. Fauver:

Enclosed is the subject report with the comments incorporated that you provided during our February 26, 1996 telephone conversation. This report provides information on the confirmatory survey activities conducted at the Fort St. Vrain Nuclear Station in Platteville, Colorado on September 25 through 27, 1995.

If you have any questions or comments, please direct them to me at (423) 576-3740 or W. L. (Jack) Beck at (423) 576-5031.

Sincerely,



Eric W. Abelquist
Assistant Program Director
Environmental Survey and
Site Assessment Program

EA:tsf

Enclosure

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**CONFIRMATORY SURVEY ACTIVITIES
FOR THE
FORT ST. VRAIN NUCLEAR STATION
PUBLIC SERVICE COMPANY OF COLORADO
PLATTEVILLE, COLORADO**

INTRODUCTION

Public Service Company of Colorado (PSC) operated a 330 MWe High Temperature Gas Cooled Reactor (HTGR) from July 1979 until August 1989. The plant, designated as the Fort St. Vrain Nuclear Station (FSV), was authorized for construction on September 17, 1968 when the U.S. Nuclear Regulatory Commission (NRC) issued a provisional construction permit. Construction was completed in December 1973 and a facility operating license, License No. DPR-34, Docket No. 50-267, was granted on December 21, 1973. Initial fuel loading commenced on December 26, 1973 and initial criticality was achieved January 31, 1974. After a prolonged period of startup testing, low-power operation and plant modifications, the plant was committed for commercial operation on July 1, 1979. Full power was achieved November 6, 1981 (PSC 1995a).

In the nuclear steam supply system for FSV, heat was produced by fission in the HTGR utilizing a uranium-thorium fuel cycle. Graphite was used for the moderator, core structure, and reflector. High temperature helium was used as the primary coolant to produce superheated and reheated steam at a temperature of 1,000°F to match conventional thermal station conditions. The entire nuclear steam supply system, including the reactor core, graphite moderator and reflector, steam generators and helium circulators, was contained within a Prestressed Concrete Reactor Vessel (PCRV).

During the operational period, FSV operated for approximately 890 effective full-power days; FSV was shut down on August 18, 1989. The PSC Board of Directors reviewed and confirmed the Executive Management decision that FSV would not be restarted, and that PSC would pursue decommissioning of FSV. The decision to permanently shut down and decommission FSV was based on related technical and financial considerations. Problems were identified with the control rod drive assemblies and the steam generator steam ring headers that presented significant technical obstacles which could be overcome, but at a significant cost in dollars and time to PSC. In addition,

due to the uniqueness of the HTGR fuel cycle, the cost to purchase new fuel was prohibitive. This, in conjunction with low plant availability and correspondingly high operating costs, made continued operation of FSV impractical.

PSC's objective is the dismantlement and decommissioning of FSV to release all site areas for unrestricted use. To accomplish this, a portion of the PCRV structure and the radioactive balance-of-plant equipment that exceed the limits for unrestricted use will be decontaminated or removed as described in the Fort St. Vrain Decommissioning Plan. In May 1991, the NRC granted a 10 CFR 50 Possession Only License. On November 23, 1992, the NRC issued the Order to Authorize Decommissioning of Fort St. Vrain and Amendment No. 85 to Possession Only License No. DPR-34 (PSC 1995b).

The FSV facility will be largely left intact following decommissioning; dismantlement of structures will be confined to the PCRV, and portions of the Reactor Building, Turbine Building, and Liquid Waste System. Removal will be for purposes of removing contaminated structures and to provide paths for removal of contaminated piping and equipment.

Following defueling, the PCRV contained the majority of the remaining radioactive material inventory. Portions of the PCRV concrete are activated due to direct irradiation from the reactor core, and will be removed prior to final survey and disposed of as radioactive waste at a licensed radioactive waste disposal facility. Thus, the radioactive source term at FSV is primarily a result of neutron activation of both metallic and concrete components of the PCRV and neutron activation of impurities contained in graphite components of the PCRV. These activation products include beta-gamma emitters such as Co-60, Eu-152, and Eu-154, and low-energy beta and x-ray emitters such as H-3, C-14, and Fe-55. It should be noted that H-3 and Fe-55 are the largest contributors to the total radionuclide inventory (PSC 1995a).

FSV's final survey will include all pertinent structures, surfaces, systems and components, concentrating on those previously identified as contaminated or potentially contaminated during the dismantlement/decommissioning phases. The final survey will include:

- Sampling outside the restricted area of PSC property, soil, pavement, water, and liquid effluent ditch and pond sediment for radioisotopic analysis and measurement of gamma exposure rate,
- Sampling inside the restricted area of PSC property, soil, basin sediment, pavement and water for radioisotopic analysis and measurement of gamma exposure rate,
- Radiological surveys of the PCRV and Reactor Building, and
- Radiological surveys of the Turbine Building, Radwaste Compactor Building, New Fuel Storage Building, Radiochemistry Laboratory, Helium Transfer and Storage System, and Liquid Radwaste System.

At the request of the NRC's Division of Waste Management, the Environmental Survey and Site Assessment Program (ESSAP) of the Oak Ridge Institute for Science and Education (ORISE) performed independent confirmatory surveys activities at the Fort St. Vrain site in Platteville, Colorado during the period September 25 through 27, 1995. Independent survey activities included licensee survey package reviews, confirmatory surface scans, and comparison surface activity measurements (e.g., side-by-side measurements).

SITE DESCRIPTION

The FSV facility is located approximately 56 kilometers (35 miles) north of Denver and 5.6 kilometers (3.5 miles) northwest of the town of Platteville, in Weld County, Colorado. The site is located in an agricultural area with gently rolling hills. Grade elevation at the plant is 1,460 meters (4,790 feet) above sea level. The site consists of 1130 hectares (2800 acres) owned by PSC, identified as the Owner-Controlled Area, of which approximately 260 hectares was designated as the exclusion area during plant operation.

The station is located approximately 3 kilometers south of the confluence of the South Platte River and the St. Vrain Creek. Neither of these two streams are considered navigable. Cooling for the plant is provided by mechanical draft cooling towers. Make-up water to the cooling towers is obtained from the two streams, and is supplemented by shallow well water. Nineteen shallow monitoring wells are located on the site. The licensee also owns surface water rights in four irrigation ditches which traverse portions of the site.

The major structures within the Restricted Area include the Reactor Building which contains the PCRV, Turbine Building, Radwaste Compactor Building, New Fuel Storage Building, Technical Support Building which contains the Radiochemistry Laboratory, Mechanical Draft Cooling Towers, Warehouse and Construction Workshops, Evaporation Ponds, and the Electrical Switchyard. The ground surface covering within the Restricted Area is composed primarily of gravel and vegetation, with smaller portions devoted to concrete or asphalt roadways and laydown areas.

OBJECTIVES

The objectives of the confirmatory survey activities were to provide NRC inspection support, including independent contractor reviews of site records and confirmatory survey data for use by the NRC in evaluating the adequacy and accuracy of the licensee's procedures and final status survey results.

PROCEDURES

During the period, September 25 through 27, 1995, ESSAP performed independent confirmatory survey activities at the Fort St. Vrain site in Platteville, Colorado. This technical assistance was provided to assist the NRC in their inspection of licensee decommissioning-related activities. Technical assistance activities included independent confirmatory surface scans, instrument comparison measurements, and a review of licensee final survey packages performed in accordance with the direction provided by the on-site NRC project manager. This report summarizes the procedures and results of the technical assistance activities.

Survey Data Package Review

ESSAP reviewed the licensee's final survey plan for site release prior to the on-site visit to become familiar with the NRC-approved final survey procedures (PSC 1995a). As part of the confirmatory activities, ESSAP reviewed selected licensee survey data packages for accuracy, completeness, and procedure compliance with their final survey plan for site release. Specifically, the survey data packages were reviewed to ensure that classification criteria have been properly followed and that any measurements exceeding investigation levels, as defined by the licensee, were adequately investigated.

ESSAP reviewed FSV survey data package B005 (an unaffected area package), which included the North Warehouse (Building 13), the Electrical Warehouse (Building 14), and the restroom and shower facility (Building 1014). Concerns identified during the review—and verbally presented to the on-site NRC project manager—included:

- survey area was classified as unaffected, although radioactive material was stored in the northeast area of the Electrical Warehouse.
- survey area was classified as unaffected, although numerous final survey surface activity measurements exceeded both the 25% of guideline action level and the guideline.
- all forms were not signed and dated.
- difficult to relate survey location code from instrument download sheets to survey map locations.

It should be noted that following our document review, the licensee stated that the survey packages being reviewed have not been completed by FSV—data reviews, investigations, and data conversions to guideline units remained to be performed. However, the concern remains that FSV classified the Electrical Warehouse as unaffected although documentation stated that Electrical Warehouse had a history of radioactive material storage, and according to their final survey plan, unaffected areas are not expected to contain residual radioactivity based on the site history.

Surface Scans and Comparison to Licensee Scan Results

Surface scans for beta activity were performed over 100% of accessible floor and lower wall surfaces (approximately 50% of the total area) in the Production Training Center (A008), including the Simulator Room (A002), and the Electrical Warehouse floor area. Scans were performed using a gas proportional floor monitor (573 cm²) coupled to a ratemeter-scaler with an audible indicator. Surface activity levels were determined from any locations of elevated direct radiation as identified by scans.

Surface scans of the Production Training Center and Electrical Warehouse identified no areas of elevated beta direct radiation. Scan ranges in survey unit A002 were consistent with background levels—1100 to 1300 cpm and 1000 to 1300 cpm for the floors and lower walls, respectively. Scan ranges in survey unit A008 were also consistent with background levels—1100 to 1400 cpm and 1100 to 1300 cpm for the floors and lower walls, respectively. The scan range on the Electrical Warehouse floor had a scan range of 1400 to 1900 cpm—consistent with background levels.

ESSAP scan results were compared to the licensee scan results documented in their survey packages for survey units A008, A002, and the Electrical Warehouse floor area. The scan results were consistent between ESSAP and the licensee—both ESSAP and the licensee concluded that surface scans identified no locations of elevated direct radiation in each of the surveyed areas.

Side-By-Side Surface Activity Measurements

Field comparisons of ESSAP and FSV direct surface activity measurements were performed in the Electrical Warehouse, Level 3 of the Reactor Building, and the Battery Room in the Turbine Building (Figures 1 through 3). Surface activity measurements for both ESSAP and the licensee were performed using 125 cm² (ESSAP states the probe area size as 126 cm²) gas proportional detectors coupled to ratemeter-scalers.

Field comparisons for background surface activity levels were performed in the Battery Room of the Turbine Building. Ten locations in the Battery Room were selected for background measurements. Table 1 illustrates the comparison of ESSAP and licensee detector response—in cpm per probe area—at each background location in the Battery Room. ESSAP performed 1 minute counts, while the licensee counted for 15 seconds at each location. The results indicate that the licensee's detector exhibits a substantially greater response—on the order of 30 to 40% higher—than ESSAP's gas proportional detector. Detector characteristics responsible for this difference may include voltage and threshold settings, dimensions of the corona wire, and grounding of the corona wire.

Twenty side-by-side surface activity measurements were acquired on floor surfaces in both the Electrical Warehouse and Level 3 of the Reactor Building. ESSAP and FSV employed different techniques to calculate the surface activity at each location. ESSAP subtracted the mean background level—determined on the concrete floor in the Battery Room—from surface activity measurements collected in the Electrical Warehouse and Level 3 of the Reactor Building. Net count rates were then converted to surface activity levels (dpm/100 cm²) by dividing the net rate by the 4π efficiency and correcting for the probe area of the detector. Both ESSAP and FSV calibrated the gas proportional detectors to Tc-99; ESSAP obtained an efficiency value of 0.25, while the FSV efficiency was 0.205.

FSV evaluated the background surface activity for a given material by dividing the background into two components: natural material (e.g., concrete) background and the local area exposure rate background. At the selected material background location, FSV collected a series of shielded counts—using a 300 mg/cm² Lucite beta shield—that represents the local area exposure rate contribution to the detector response, followed by unshielded measurements that include the contribution from both the local area exposure rate and the natural material background. The difference of these two values yields the natural material background for a specific material (i.e., concrete, steel, wood, etc.)—for concrete it was 767 dpm/100 cm². This natural material background, plus the specific local area exposure rate contribution to the detector response determined for the survey unit being evaluated, was subtracted from the gross surface activity measurements in the Electrical Warehouse. Because ESSAP does not account for a changing local

area exposure rate contribution to the detector response from where the initial material background levels were established, the material backgrounds subtracted by ESSAP and FSV were different.

Since FSV only provided local area background-corrected surface activity levels in the Electrical Warehouse—shielded surface activity measurements were not performed by FSV on the floor in Level 3 of the Reactor Building—data comparisons were not performed for the Reactor Building. Table 2 illustrates the surface activity comparison results for the Electrical Warehouse. Surface activity levels measured by ESSAP ranged from 103 to 569 dpm/100 cm², with an average of 301 dpm/100 cm² and standard deviation of 144 dpm/100 cm². FSV reported surface activity levels ranged from -267 to 560 dpm/100 cm², with an average of 199 dpm/100 cm² and standard deviation of 231 dpm/100 cm². A pairwise comparison *t*-test was performed to determine if the differences between ESSAP and FSV were statistically significant. Based on the pairwise comparison *t*-test, there are no statistically significant differences ($p > 0.05$) between FSV's and ESSAP's surface activity measurements in the Electrical Warehouse.

SUMMARY

During the period September 25 through 27, 1995, the Environmental Survey and Site Assessment Program of ORISE performed confirmatory survey activities at the Fort St. Vrain site in Platteville, Colorado. Confirmatory survey activities included survey data package reviews, confirmatory surface scans, and side-by-side background and surface activity measurements.

Document reviews identified a discrepancy in an area classification during the review of survey data package B005. Other minor concerns identified by ESSAP during the survey data package review were dismissed because FSV reported that they had not yet completed their review of survey data package B005.

ESSAP confirmatory surface scans in survey units A008, A002, and the Electrical Warehouse floor identified no locations of elevated direct radiation. These results are consistent with the scan results documented in the licensee's survey data packages.

Comparisons of ESSAP and FSV gas proportional detector response in the Battery Room of the Turbine Building indicate that the licensee's detector exhibits a significantly greater response than ESSAP's gas proportional detector. Side-by-side surface activity measurements in the Electrical Warehouse indicate that there are no statistically significant differences between FSV's and ESSAP's surface activity measurements in unaffected areas that exhibit background or near background levels—i.e., where no licensed material is present.

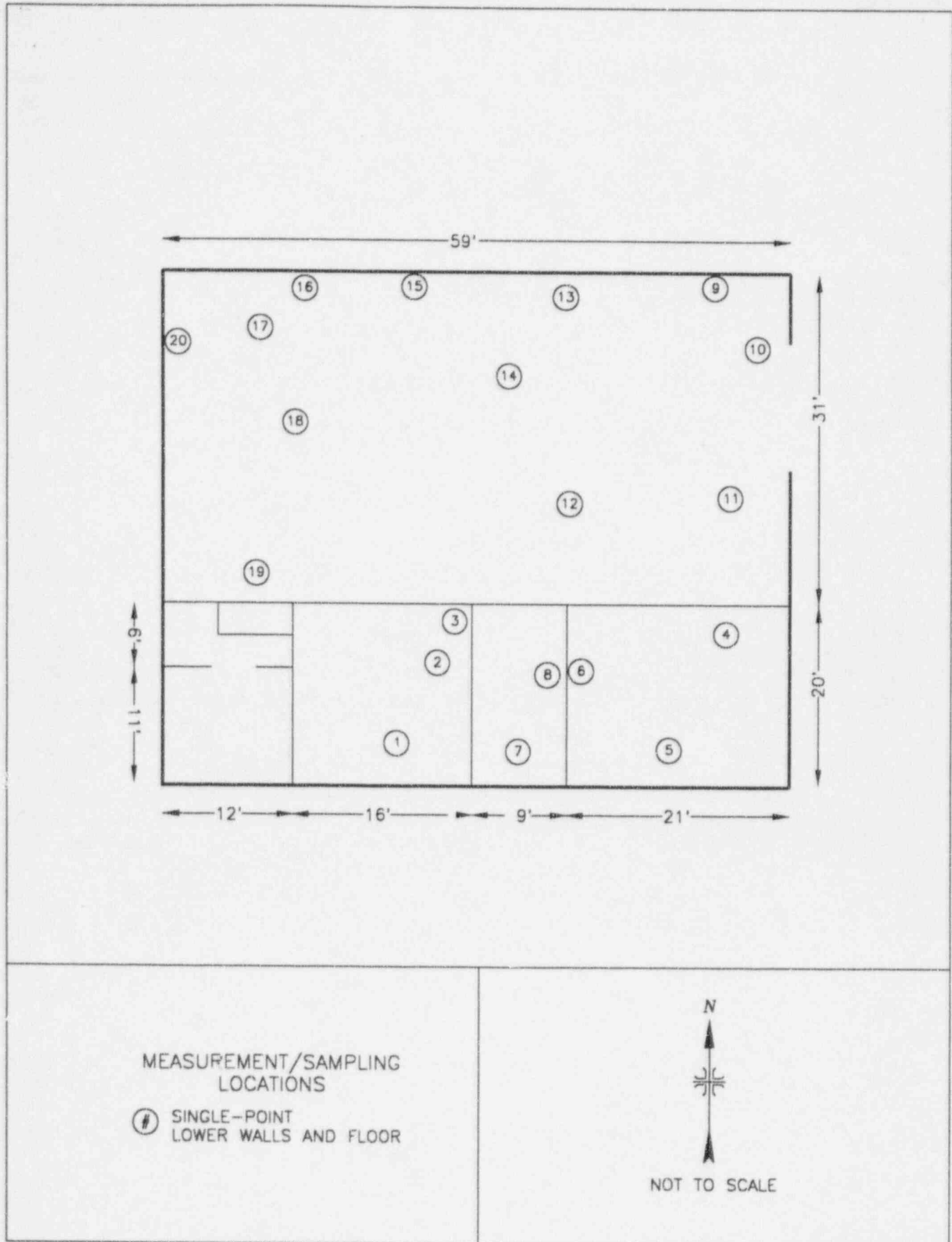
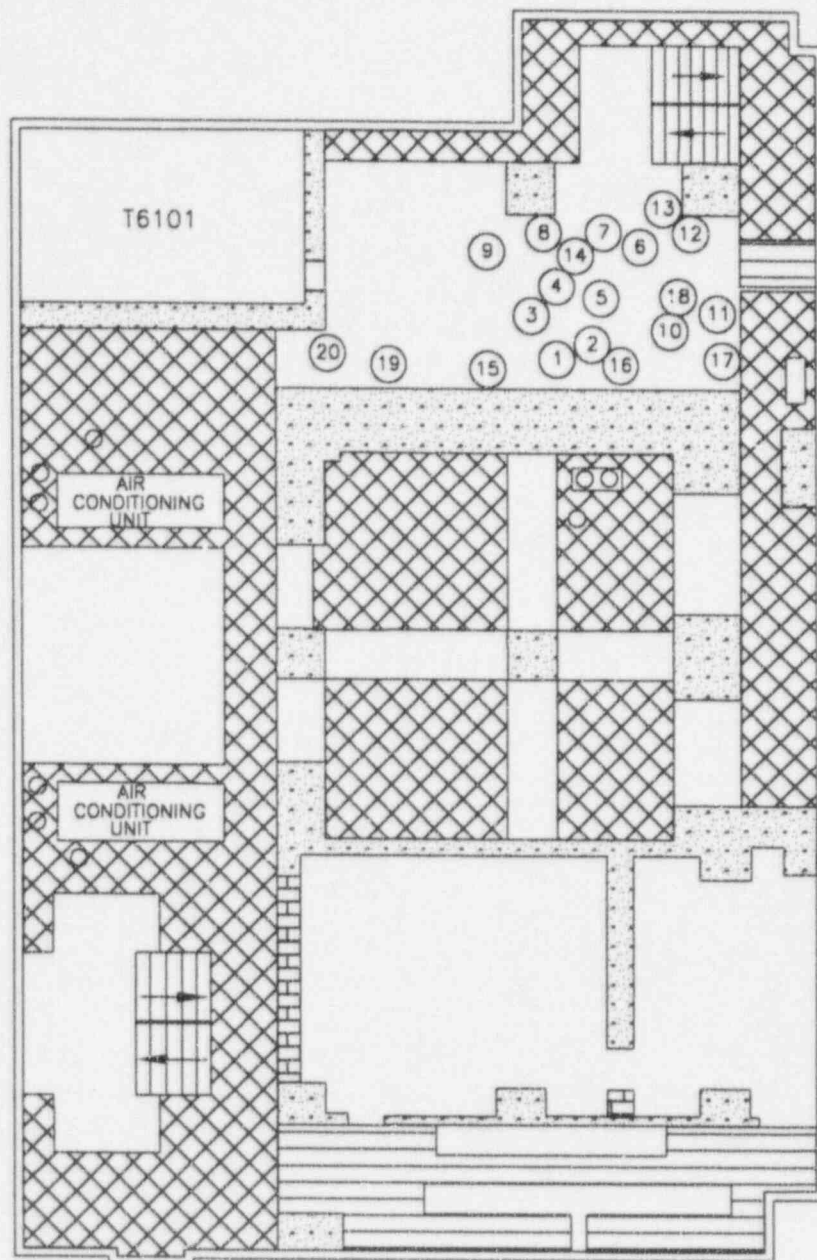


FIGURE 1: Fort St. Vrain Facility, Electrical Warehouse #14 - Measurement and Sampling Locations



MEASUREMENT/SAMPLING LOCATIONS

- ① SINGLE-POINT
LOWER WALLS AND FLOOR

- GRATING
- CONCRETE
- CONCRETE BLOCK
- DIAMOND PLATE



NOT TO SCALE

FIGURE 2: Fort St. Vrain Facility, Reactor Building, Level 3, East –
Measurement and Sampling Locations

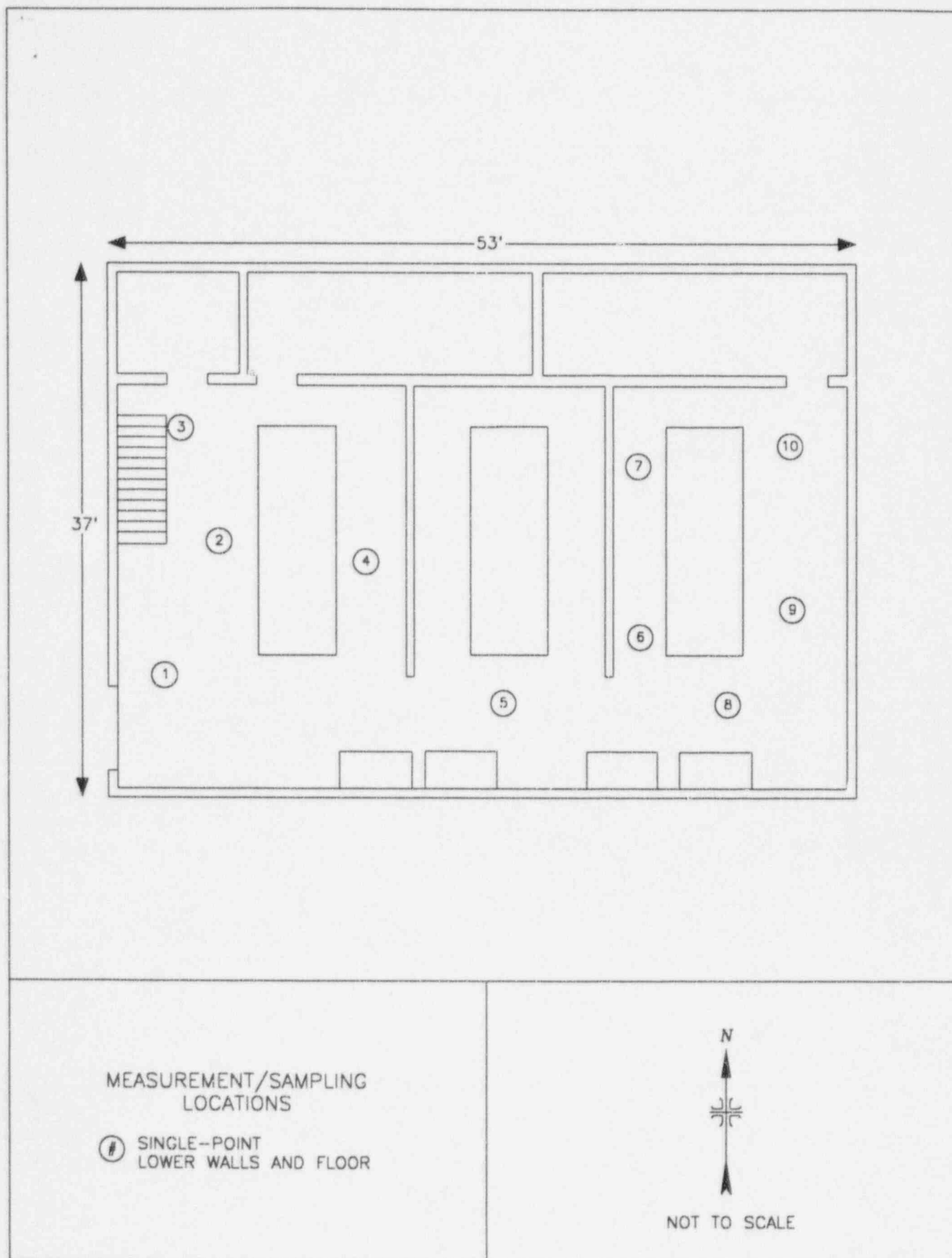


FIGURE 3: Fort St. Vrain Facility, Turbine Building, Level 5, Section C014 – Measurement and Sampling Locations

TABLE 1

**COMPARISON OF DETECTOR RESPONSE FOR BACKGROUND MEASUREMENTS
BATTERY ROOM IN TURBINE BUILDING
FORT ST. VRAIN
PLATTEVILLE, COLORADO**

Location ^a	Count Rate (cpm/125 cm ²)		
	ESSAP ^b	FSV ^c	Relative % Difference ^d
Battery Room in Turbine Building			
1	436	592	35.8%
2	448	620	38.4%
3	467	572	22.5%
4	507	548	8.1%
5	472	616	30.5%
6	466	608	30.5%
7	447	580	29.8%
8	476	620	30.2%
9	433	540	24.7%
10	428	696	62.6%

^aRefer to Figure 3.

^bESSAP performed 1 minute counts.

^cFSV performed 15 second counts.

^dRelative percent difference calculated by:

$$\left(\frac{FSV - ESSAP}{ESSAP} \right) \times 100\%$$

TABLE 2
COMPARISON OF SURFACE ACTIVITY MEASUREMENTS
ELECTRICAL WAREHOUSE
FORT ST. VRAIN
PLATTEVILLE, COLORADO

Location ^a	Beta Activity (dpm/100 cm ²)	
	ESSAP	FSV
Electrical Warehouse		
1	423	279
2	268	216
3	103	560
4	509	357
5	569	263
6	341	544
7	562	435
8	387	-2
9	265	-267
10	400	310
11	169	170
12	228	482
13	152	138
14	291	248
15	215	123
16	255	341
17	142	45
18	420	-189
19	155	-111
20	162	45

^aRefer to Figure 1.

REFERENCES

Public Service Company of Colorado (PSC 1995a). Final Survey Plan for Site Release (revision 1). Fort St. Vrain Nuclear Station Decommissioning Project. May 25, 1995.

Public Service Company of Colorado (PSC 1995b). Final Survey Report for Release of Repower Area. Fort St. Vrain Nuclear Station Decommissioning Project. March 2, 1995.