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June 13, 1988

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: McGuire Nuclear Station
Docket Numbers 50-369 and 50-370
Reply to Request for Additional Information
Regarding Unresolved Item 50-369,-370/87-13-01

Gentlemen:

By letter dated April 28, 1988, NRC staff requested additional information to complete review of subject item. Attached find additional information that was requested, and a correction to information provided in Duke's April 25, 1988 letter concerning the subject matter.

Should there be any further questions regarding this subject, please contact S.E. LeRoy at (704) 373-6233.

Very truly yours,

J.W. Hampton, for
Hal B. Tucker

SEL/283/bhp

Attachment

xc: Dr. J. Nelson Grace, Regional Administrator
U. S. Nuclear Regulatory Commission
101 Marietta St., NW, Suite 2900
Atlanta, Georgia 30323

Mr. Darl Hood
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Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Mr. W. T. Orders
NRC Senior Resident Inspector
McGuire Nuclear Station

IE01
1/1

bxc: R. G. Eble
J. W. Foster
R. O. Sharpe
R. L. Gill, Jr.
N. A. Rutherford, Jr.
MC-815.01 (369, 370/87-13)
(6)

RESPONSE TO REQUEST FOR
ADDITIONAL INFORMATION REGARDING RADIOIODINE
AND PARTICULATE SAMPLING AT THE McGUIRE
NUCLEAR STATION, DOCKET NOS. 50-369 AND 50-370

By letter dated April 28, 1988, NRC Staff requested the following information:

1. Describe the stock velocity profile study performed in 1981 and provide date or a summary of the data that demonstrates that representation sampling will be provided.

   See Attachment 1 which provides the requested information.

2. Provide a description of Nuclear Station Modification (NSM) MG-1-1623 and MG-2-0588.

   The NSMs in question will provide additional tubing to allow remote particulate and iodine grab sampling, post LOCA. Any sections of tubing exposed to a cold environment will be insulated and heat traced. All inlet tubing will have a minimum of plate out locations such as 90 degree elbows, etc. Attachment 2 provides a sketch of the grab sampling equipment.

3. a. Describe the equipment and procedures that will be used to continuously sample gaseous effluents post LOCA.

      To provide continuous sampling under post LOCA conditions a remote sampler is being installed per the previous discussed NSMs. The remote sampler will sample from the unit vent stack sampling point currently in use. Attachment 2 provides a sketch of the grab sampling equipment.

   b. Provide an estimate of the doses that a worker would receive as a result of exposure during sampling handling, transport, and analysis, the basis for the estimated doses, and describe the provisions DPC has taken to limit exposure during the aforementioned process.

      Refer to Attachment 3 for calculated dose rates from an unshielded iodine sample cartridge. The dose rates are based on the following accident analysis assumption:

      1. Maximum instantaneous iodine concentrations in the unit vent from post accident effluent calculations are assumed to be sampled for 30 minutes;

      2. Maximum particulate filter activation is assumed based on conservative release assumptions;

      3. Sample time of 30 minutes;

4. Sampler flowrate of 0.8 cfm and 100% efficient filter and cartridge; and

5. Sampler construction 3/8" thick aluminum alloy.

Using six minutes handling time, the extremity dose is 350 mrem and the whole body dose is 5 mrem assuming 14 minutes exposure. To maintain doses ALARA, handling times will be minimized and the sample handled with long handled tools when possible. Shielding may be provided to lower dose rates if no interference with measurements can be assured. The correlation of iodine and particulate concentration on the filter to dose rate assumes no scatter contribution as may be present with a shielded sample.

4. Would the use of the "Procedure for Quantifying High Level Radioactivity Releases During Accident Conditions" limit DPC's ability to retrieve samples?

DRC believes that the ability to retrieve samples using the aforementioned procedure will not be limited due to occupational exposure for the following reasons:

a. The remote sampler provides the ability to sample in an area of the plant that has lower general area dose rates;

b. The design of the remote sampler incorporates quick disconnects, etc., to allow shorter handling times during the sampling process; and

c. Based on DPC's post DBA-LOCA analysis the resultant dose rates (contact) of the sample will be 9.0 R/hr.

By letter dated April 25, 1988, DPC transmitted information regarding the basis for a valve of 0.033 microcuries per CC for unit vent particulate and iodine activity. The valve disagreed with the 100 microcuries per CC Design Basis Shielding Envelope Criteria mentioned in NUREG 0737. A recalculation of the dose assessment and correlation of activity built up on the remote cartridge filter has substantiated the criteria of NUREG-0737, Item II.F.1. The valve of 100 microcuries per milliliter was initially misunderstood to represent the maximum iodine and particulate concentration in the unit vent. This value can only reasonably represent the maximum concentration built up on the cartridge filter. Comparing resultant dose rates for the NUREG position verses DPC results snows the similarity of the conditions and basis for this position.

	NUREG CRITERIA	DPC ANALYSIS
Maximum Concentration on Filter	100 Micro Ci/CC	63 Micro Ci/CC I-131 equivalent (Thyroid dose) collected 1st 30 minute post DBA-LOCA
Average Gamma Energy	0.5 Mev	0.83 Mev at T = 0
Resultant Dose Rate (contact)	10.4 R/Hr	9.0 R/Hr

This value actually represents a maximum concentration in the unit vent averaged over the first few minutes post DBA-LOCA.

The valve of 0.033 microcuries per CC concentration was incorrectly reported to represent the maximum concentration on the filter media in DPC's April 25, 1988 letter to the NRC.

ATTACHMENT 1

CERTIFICATION OF ENGINEERING CALCULATION

FOR INFORMATION ONLY

Station and Unit Number McGuire Unit 1

Title of Calculation Verification of Unit Vent Sample Probe Design and Installation

Calculation Number MCC-1211.00-68 Originally consisting of Pages 1 of 14 through 14 of 14.

These Engineering Calculations cover QA CONDITION 0 items. In accordance with established procedures, the quality has been assured and I certify that the above calculation has been performed, checked or approved as noted below:

Performed by J. L. Richardson Date 6-10-81

Checked by H. A. Smith Date 6-11-81

Approved by [illegible] Date 6-12-81

Issued to General Services Division ____ Date ____

Received by General Services Division ____ Date ____

Revision/Addenda Log:

No.	Pages Revised	Pages Deleted	Pages Added	Performed By / Date	Checked By / Date	Approved By / Date	Issue Date / Rec'd Date

Form 101.1/Revision 6

Form 184 (5 76)

Dev./Station McGuire Unit 1 File No. MCC-1211.00-68

Subject Verification of Unit Vent Sample Probe Design and Installation By JLR Date 6-8-81

Sheet No. 1 of 14 Problem No. ______ Checked By KAS Date 6-11-81

FOR INFORMATION ONLY

Purpose

The purpose of this analysis is to verify that the Unit Vent Radiation Monitor sample probe is compatible with the actual vent flow distribution, and to verify that the probe design complies with Appendix A of ANSI N13.1-1969.

Methodology

I. A comparison will be made between the actual vent flow distribution versus the design basis distribution of the sample probe. The actual flow distribution was recorded on April 24, 1981, by Duke engineers, and the related test report will be used as the basis for this comparison.

II. The actual probe configuration and location will be examined for compliance with applicable sections of ANSI N13.1-1969, Appendix A. This ANSI document contains very specific guidelines for design and installation of sampling devices, and a detailed analysis of the McGuire probe will be performed.

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Dev./Station ______ Unit ___ File No. ___

Subject ______

By JLP Date 6-10-81

Sheet No. 2 of 14 Problem No. ______ Checked By HAS Date 6-11-81

FOR INFORMATION ONLY

References

① ANSI N13.1-1969, Appendix A

② Test Report on Unit Vent Velocity Profile prepared by Steam Production Department, dated April 29, 1981

③ Duke Power Drawings MC-1091-11 and MC-1091-12 for Unit Vent details

④ General Atomic Company Drawing ELE321-8010 for sample probe details.

⑤ Basic Heat Transfer, by M.N. Ozisik, Table A-1, "Properties of Gases," and page 238, "Fundamentals of Turbulent Flow."

Analysis

I. Compare the "as-tested" vent stack flow distribution with the design basis distribution of the sample probe.

From Ref ④, it can be seen that all sample taps are of equal diameter, i.e., the sample probe was designed based on a flat

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FOR INFORMATION ONLY

By JLR Date 6-10-81

Sheet No. 3 of 14 Problem No. ______ Checked By HHS Date 6-11-81

velocity profile. In a flat profile situation, the maximum velocity is equal to the average velocity.

In the unit vent flow distribution test report (Ref ②), one type of traverse was performed to determine the profile that the probe would "see." This is labelled "ANSI Code Traverse" and was performed at two (2) different vent flows to determine profile changes with respect to total flow. Results are tabulated on pages 6, 7, 8 and 9 of Ref. ②.

Determine percent variation between the flat profile and the measured profile for each Stack flow rate

Test No. 1 (Ref ②, pages 6 & 8)
Average Velocity = 24.80 ft/sec

Point	Meas. Vel.	Average Vel.	Δ %
1	21.75	24.6	-11.6 %
2	25.74	"	+4.6
3	25.74	"	+4.6
4	25.74	"	+4.6
5	24.80	"	+0.8
6	23.83	24.6	-3.1

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Dev./Station ______ Unit ____ File No. ______

Subject ______

FOR INFORMATION ONLY

By JLR Date 6-10-81

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Test No. 2 (Ref. ②, pages 7 & 9)
Average Velocity = 45.12 ft/sec

Point	Meas Vel.	Average Vel	Δ %
1	42.42	44.99	-5.7
2	46.16	"	+2.6
3	47.17	"	+4.9
4	47.17	"	+4.9
5	44.60	"	-0.9
6	42.42	44.99	-5.7

The above errors are due to boundary effects on the airstream, ie, the flowstream is somewhat slower at the stack wall than in the center. These effects are only slight, and the test results are indicative of a fully turbulent, well mixed flow profile.

Compute the Reynold's Number at the minimum test flow to verify the presence of fully turbulent flow ($Re > 40,000$, Ref. ⑤

$Re = \frac{DV}{\nu}$, where D = nominal 7' stack diameter

V = average flow velocity, ~25 ft/sec

$\nu = \frac{0.63 ft^2}{hr}$ at 76.8 °F

from Ref. ⑤, Table A-

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Dev./Station: FOR INFORMATION ONLY Unit File No.

Subject

By JLR Date 6-10-81

Sheet No. 5 of 14 Problem No. Checked By HAS Date 6-11-81

$$Re = 7\,ft \times 25\,\frac{ft}{sec} \times \frac{1\ hr}{0.63\,ft^2} \times \frac{3600\,sec}{hr}$$

$$Re = 1 \times 10^6$$

Due to the large stack diameter, even an extremely low velocity of 1 ft/sec will result in fully turbulent flow. thus the chance for stratification is essentially non-existent.

The conclusion from the preceding analysis is that the flow stream is fully turbulent and well mixed, and that the velocity profile is sufficiently flat to be compatible with the probe design.

II. The second portion of the analysis is to perform a detailed, independent verification of the probe design. This will include an item-by-item comparison with the applicable portions of ANSI N13.1-1969, Appendix A.

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FOR INFORMATION ONLY

Dev./Station ______ Unit ____ File No. ____

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By JLR Date 6-10-81

Sheet No. 6 of 14 Problem No. ______ Checked By Kms Date 6-11-81

A. ANSI Section A_2 - Selection of Sampling Position Along Stack

The following is a brief summary of Section A_2:

1) The recommended sample point should be a minimum of five (5) diameters downstream of previous disturbances and preferably ten (10) or more
2) The velocity distribution should be measured near the sample point to determine if flow is fully developed and mixing is complete.
3) Sampling from a vertical run is preferred over a horizontal run

Response:

1) From Ref. ③, the unit vent sample probe is located at Elevation 847'. The last tie-in to the vent is at El 804'-7", for the SJAE discharge (ZJ System). This particular line is separately monitored prior to junction with the unit vent. The last downstream tie-in that is not separately monitored is a WL System tank vent at El 785. Usir this WL line as the basis

for the last flow disturbance, then the separation is:

847' - 785' = 62 feet

$$\frac{62 \text{ feet}}{7 \text{ ft diam (nom.)}} = 8.8 \text{ diameters}$$

By comparison to the recommended 5 to 10 diameters, the location is considered acceptable.

2) A velocity distribution test was performed at El. 846. The test report is Ref. ②, and has been discussed in Section I. of this analysis

3) The sample probe is located in a vertical flowpath such that stratification due to gravity is not present

B. <u>ANSI Section A3 - Sample Tap Locations in the Cross Section of Stack</u>.

The following is a brief summary of Section A3:

1) For large circular stacks greater than 50 inches in diameter, there should be

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a minimum of six (6) sample withdrawal points.

2) Each withdrawal point should be centered in an equal annular area of size equal to the total cross-sectional area divided by the number of withdrawal taps.

Response:

1) From GAC drawing (Ref. ④), the sample probe contains six (6) taps. The unit vent nominal diameter is 84," therefore the number of taps is acceptable.

2) Using ANSI guidelines, perform independent calculations of tap spacing, and compare results with the GAC design.

Divide the unit vent cross-sectional area into six (6) equal parts. The innermost area will be circular. The five remaining areas will be annular shaped.

$I.D = 6'\text{-}11\frac{3}{8}'' = 83.375''$

$C.S\ Area = \frac{\pi (83.375^2)}{4} = 5460\ in^2$

$C.S\ Area\ per\ part = 5460/6 = 910\ in^2$

Determine diameter of circle

$\pi D_1^2/4 = 910$

$D_1 = \sqrt{\frac{4 \times 910}{\pi}} = 34.04$ $R_1 = 17.02$ ✓

Determine O.D. of second area

$\frac{\pi}{4}(D_2^2 - 34.04^2) = 910$

$D_2 = \sqrt{\frac{4 \times 910}{\pi} + 34.04^2} = \sqrt{1158.65 + 1158.57}$

$D_2 = 48.14$ $R_2 = 24.07$ ✓

Determine O.D. of third area

$\frac{\pi}{4}(D_3^2 - 48.14^2) = 910$

$D_3 = \sqrt{1158.65 + 48.14^2}$

$D_3 = 58.96$ $R_3 = 29.48$ ✓

Determine O.D. of fourth area

$\frac{\pi}{4}(D_4^2 - 58.96^2) = 910$

$D_4 = \sqrt{1158.65 + 58.96^2}$

$D_4 = 68.08$ $R_4 = 34.04$ ✓

Determine O.D. of fifth area

$\frac{\pi}{4}(D_5^2 - 68.08^2) = 910$

$D_5 = \sqrt{1158.65 + 68.08^2}$

$D_5 = 76.12$ $R_5 = 38.06$ ✓

Determine O.D. of sixth area (to check)

$\frac{\pi}{4}(D_6^2 - 76.12^2) = 910$ $D_6 = \sqrt{1158.65 + 76.12^2}$

$D_6 = 83.38 \sim 83.375$ OK $R_6 = 41.69$

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By JLR Date 6-10-81

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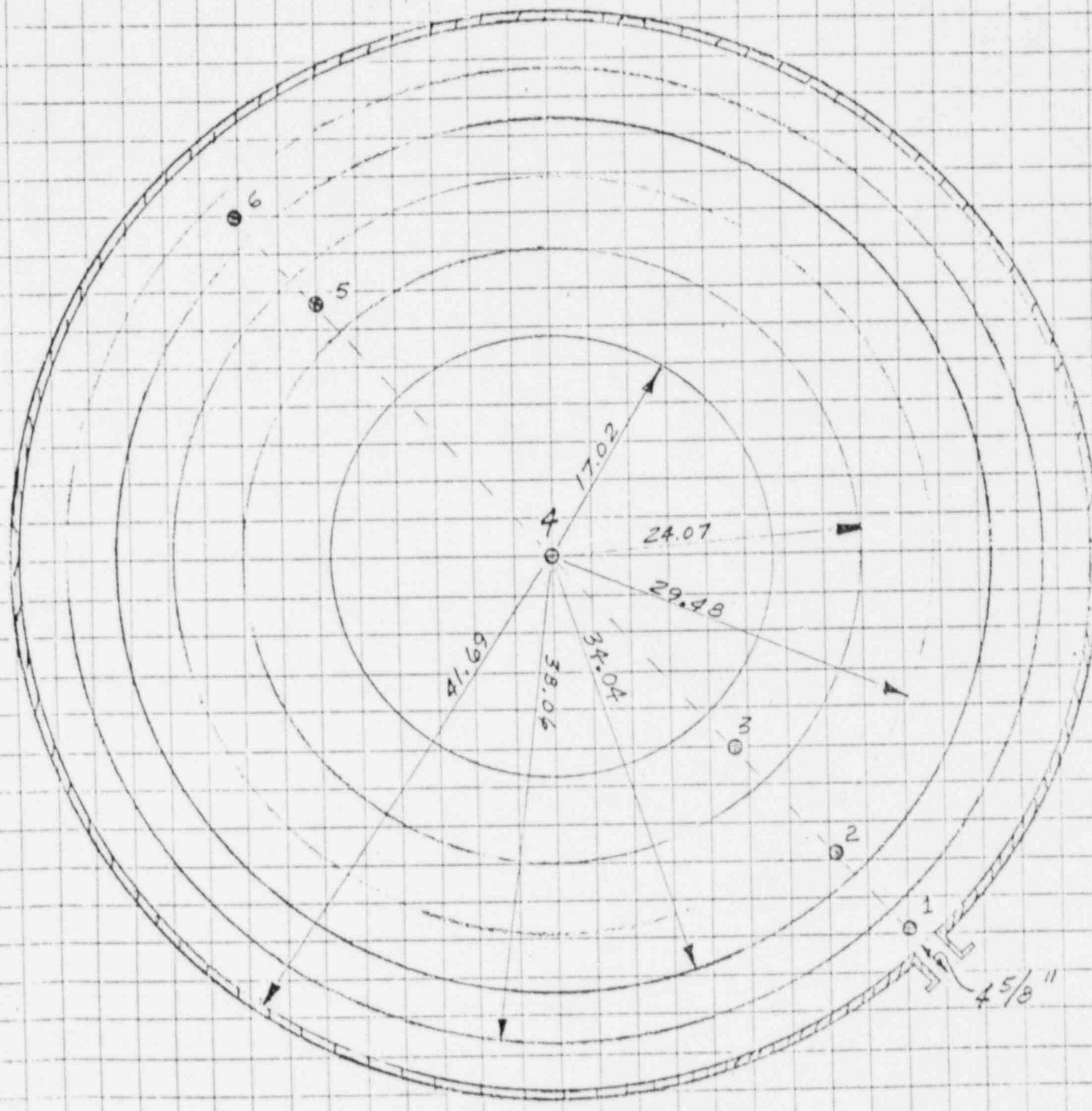

Plan of Unit Vent — Layout of Sample Probe Taps for Verification of General Atomic Design

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By JLR Date 6-10-81

Sheet No. 11 of 14 Problem No. Checked By HnS Date 6-11-81

Based on the schematic of the unit vent on the previous sheet, determine the six (6) tap locations referenced to the wall of the unit vent.

Point 1

$$d = \frac{41.69 - 38.06}{2} = \frac{3.63}{2} \rightarrow \quad 1.82$$

Point 2

$$d = 41.69 - 29.48 - \frac{(34.04 - 29.48)}{2} = \quad 9.93$$

Point 3

$$d = 41.69 - 17.02 - \frac{(24.07 - 17.02)}{2} = \quad 21.15$$

Point 4

$$d = 41.69 \rightarrow \quad 41.69$$

Point 5

$$d = 41.69 + 24.07 + \frac{(29.48 - 24.07)}{2} = \quad 68.47$$

Point 6

$$d = 41.69 + 34.04 + \frac{(38.06 - 34.04)}{2} = \quad 77.74$$

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Per Detail B of MC-1091-12, the flange supplied by D.P.Co for mounting the sample probe is mounted such that flange face is 4 5/8" from unit vent inside surface. To verify dimensions on Gen. Atomic dwg. ELE321-8010, which are referenced to the flange face, the dimensions on the preceding page must be increased by 4 5/8".

Distance from Tap to Wall	Correction due to Flange	Corrected Distance	Gen Atom Dimension
1.82	4.625	6.44	6.16
9.93	4.625	14.56	14.3
21.15	4.625	25.78	25.5
41.69	4.625	46.32	46.20
68.47	4.625	73.10	73.16
77.74	4.625	82.37	82.50

As evidenced in the two rightmost columns above, the tap locations selected by the vendor are essentially in compliance with Section A3.2 of Appendix A of ANSI-N13.1-1969. This aspect of the probe design is considered satisfactory.

C. ANSI Figure A5 - Detailed Design of Sample Taps for Multiprobe Sampler

The following is a brief summary of Figure A5 recommendations:

1) The straight portion of each withdrawal tap should be approximately 5D in length, where D is the outside diameter of the tubing.
2) Minimum bend radius of taps should be ≥5D

Response:

1) From GAC drawing (Ref. ④), the minimum straight tap length is 1.25." The tap tubing is nominal $\frac{5}{16}$", so length $L = 5 \times \frac{5}{16} = 1.56"$. This is only a slight variation from the recommended length and is considered acceptable.

2) From Ref. ④, the minimum bend radius is shown as 1.5." This compares well with 5D = 1.56, and is acceptable.

Conclusion

The preceding analysis has examined the McGuire Unit 1 Vent Stack Sample probe considering the following parameters:

1) Compatibility of the "as-tested" vent flow distribution with the design basis distribution for the probe.

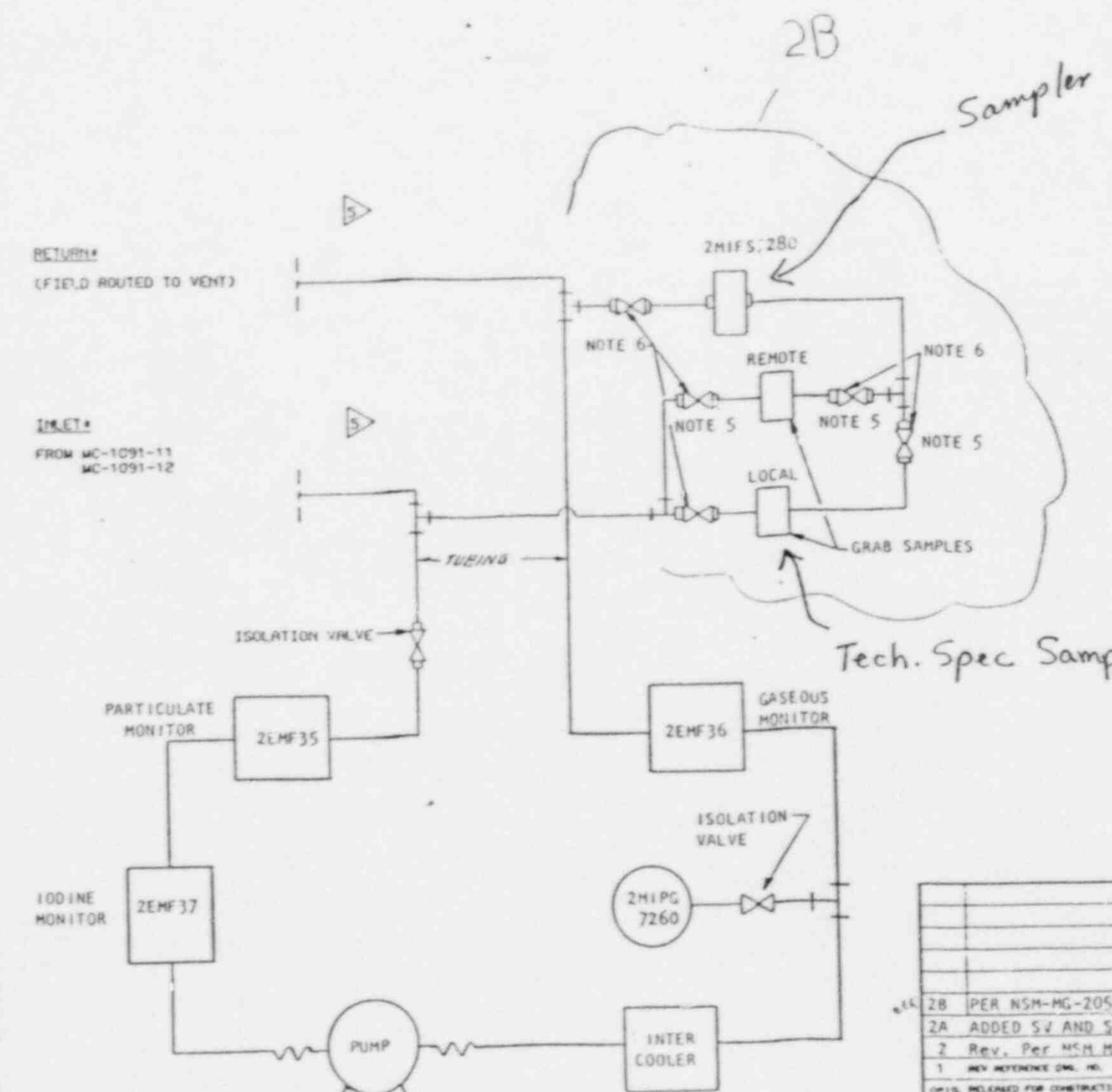
2) Location of the probe with respect to a fully turbulent, well mixed flow stream.

3) General probe geometry as set forth in Ref. ① including:
   a) Tap locations in the stack
   b) Number of taps
   c) Tap length and bend radius

Based on information in the reference material and in light of the preceding analysis, the probe design and installation conforms to good engineering practice and to the applicable industry standard.

ATTACHMENT 2

R. CARROLL MC 2565EP



NOTES:

1. 2EMF35 (H) AND (L), 2EMF36 (H) AND (L) AND 2EMF37 ARE LOCATED IN THE ENCLOSURE.
2. FOR INSTALLATION OF ISOKINETIC SAMPLE NOZZLE, REFER TO MCM-1346.05-124.
3. TUBING NOT TO CONTAIN ANY 90° ELBOWS. LARGE RADIUS BENDS REQUIRED.
4. SAMPLE POINT LOCATION IS TO BE DETERMINED BY CONSTRUCTION (I&C) AND STEAM PRODUCTION.
5. VALVES TO BE LOCATED AT THE REMOTE GRAB SAMPLE LOCATION.
6. 3/4" FULL PORTED BALL VALVES (GRINNELL 1560, MMIS # 254201442)

FOR INFORMATION ONLY

REFERENCE DRAWINGS:

MC-1201-2 ———— MONITOR LOCATION
MCM-1346.05-79 ———— OUTLINE DRAWING
MCM-1346.05-7? ———— ISOKINETIC SAMPLE NOZZLE

~~Working Copy~~
~~Controlled~~

Revised Per NSM: MG-2-588/00
Revision Date: 3-3-88
Implementation Date:

This is a limited edition print and shall not be used as a permanent record.

NO.	REVISIONS	DRN	CHKD	DATE	APPR	DATE	CIVIL	ELEC.	MECH
2B	PER NSM-MG-20588/00	[illegible]	[illegible]	3/2/88	[illegible]	[illegible]	N/R	[illegible]	[illegible]
2A	ADDED SV AND SHIELD WALL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	N/R	[illegible]	N/R
2	Rev. Per NSM MG-20336/00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	N/R	[illegible]	N/R
1	REV REFERENCE DWG. NO.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	N/R	[illegible]	N/R
ORIG.	RELEASED FOR CONSTRUCTION	[illegible]	3-23-81	[illegible]	3-31-81		N/R	[illegible]	N/R

DUKE POWER COMPANY
MCGUIRE NUCLEAR STATION UNIT 2

INSTRUMENT DETAIL
UNIT VENT RADIATION MONITOR

DWG. NO. MC-2499-MI6 REV. 2B

FOR INFORMATION ONLY

ATTACHMENT 3

Maximum Doserate From Iodine Sample Cartridge