Attachment 3 to 2.04.115

Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Plant
Proposed Amendment to the Technical Specifications

Areva Document No. 32-5052821-01, "Determination of Atmospheric Dispersion Factors for Accident Analyses Using Reg Guide 1.145 and 1.194 Methodologies" (80 pages);

Areva Document No. 32-5052036-00, "Evaluation of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data" (32 pages); and

Areva Document No. 32-5052125-00, "Conversion of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data for Use With ARCON96" (16 pages)

20032-33 (6/23/2004)

AREVA JOE 12/6/04

DOCUMENT RELEASE NOTICE

RELEASE DATE 12/6/04

RM INITIALS JOE

CONTRACT NUMBER	PLANT	CC OR CHARGE NUMBER	
~~4170702~~ 4170698	Pilgrim Station	4170702	PAGE 1 OF 1

PART OR TASK No. (N/A If Not Applicable)	DOCUMENT NUMBER	DOCUMENT TITLE	SAFETY CLASS. (S/NS)	PUL (Y/N)	COLD (Y/N)	COM (Y/N)
N/A	32-5052821-01	Determination of Atmospheric Dispersion Factors for Accident Analyses Using Reg Guilde 1.145 and 1.194 Methodologies	S	N	Y	N

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CALCULATION SUMMARY SHEET (CSS)

Document Identifier 32-5052821-01

Title Determination of Atmospheric Dispersion Factors for Accident Analyses Using Reg Guide 1.145 and 1.194 Methodologies

PREPARED BY:

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COST CENTER 41758 REF. PAGE(S) 14-15

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METHOD: ☒ DETAILED CHECK ☐ INDEPENDENT CALCULATION

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TM STATEMENT: REVIEWER INDEPENDENCE

PURPOSE AND SUMMARY OF RESULTS:

Purpose

Determine atmospheric dispersion factors for accident analyses using Regulatory Guide 1.145 and 1.194 methodologies as requested in Entergy/Pilgrim Contract Order Number 4500534887 (Reference 1).

Results

Atmospheric dispersion factors (χ/Q's) determined using Regulatory Guide 1.145 and 1.194 methodologies and suitable for use in accident analyses are presented in Section 7.0.

Purpose and Reason for Revision

This calculation was revised to: correct a typographical error on page 6, to provide an explanation of why five years of meteorological data were used in the analysis, to provide a new compact disk to the client.

This calculation is safety related and was prepared under the AREVA/Framatome ANP Quality Assurance Program.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV	CODE/VERSION/REV
aeolus3 1.0	
ARCON96 1.0	

THE DOCUMENT CONTAINS ASSUMPTIONS THAT MUST BE VERIFIED PRIOR TO USE ON SAFETY-RELATED WORK

☐ YES ☒ NO

Framatome ANP, Inc., *an AREVA and Siemens company*

RECORD OF REVISIONS

(Note that in addition to this record of revisions page, revision bars have been included on affected pages.)

Revision Number	Section	Description
1	All	Changed revision number portion of the calculation number from 00 to 01.
1	Record Of Revisions, page 2	Added changes to the Record of Revisions page.
1	3.0, page 6	Fixed typographical error in section three - change met data dates from 1999 – 2001 to 1996 – 2000. Added footnote with explanation of why five years of meteorological data were used and why the 1996 – 2000 period was used.
1	Compact Disc	Provided new compact disc with met data file times that match those in Attachment C.

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DESIGN VERIFICATION CHECKLIST

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Title Determination of Atmospheric Dispersion Factors for Accident Analyses Using Reg Guide 1.145 and 1.194 Methodologies

1.	Were the inputs correctly selected and incorporated into design or analysis?	☑ Y	☐ N	☐ N/A
2.	Are assumptions necessary to perform the design or analysis activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent re-verifications when the detailed design activities are completed?	☑ Y	☐ N	☐ N/A
3.	Are the appropriate quality and quality assurance requirements specified? Or, for documents prepared per FANP procedures, have the procedural requirements been met?	☑ Y	☐ N	☐ N/A
4.	If the design or analysis cites or is required to cite requirements or criteria based upon applicable codes, standards, specific regulatory requirements, including issue and addenda, are these properly identified, and are the requirements/criteria for design or analysis met?	☐ Y	☐ N	☑ N/A
5.	Have applicable construction and operating experience been considered?	☐ Y	☐ N	☑ N/A
6.	Have the design interface requirements been satisfied?	☐ Y	☐ N	☑ N/A
7.	Was an appropriate design or analytical method used?	☑ Y	☐ N	☐ N/A
8.	Is the output reasonable compared to inputs?	☑ Y	☐ N	☐ N/A
9.	Are the specified parts, equipment and processes suitable for the required application?	☐ Y	☐ N	☑ N/A
10.	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?	☐ Y	☐ N	☑ N/A
11.	Have adequate maintenance features and requirements been specified?	☐ Y	☐ N	☑ N/A
12.	Are accessibility and other design provisions adequate for performance of needed maintenance and repair?	☐ Y	☐ N	☑ N/A
13.	Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?	☐ Y	☐ N	☑ N/A
14.	Has the design properly considered radiation exposure to the public and plant personnel?	☐ Y	☐ N	☑ N/A
15.	Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?	☐ Y	☐ N	☑ N/A
16.	Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?	☐ Y	☐ N	☑ N/A
17.	Are adequate handling, storage, cleaning and shipping requirements specified?	☐ Y	☐ N	☑ N/A
18.	Are adequate identification requirements specified?	☐ Y	☐ N	☑ N/A
19.	Is the document prepared and being released under the FANP Quality Assurance Program? If not, are requirements for record preparation review, approval, retention, etc., adequately specified?	☑ Y	☐ N	☐ N/A

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DESIGN VERIFICATION CHECKLIST

Document Identifier: 32-5052821-01 - Page 4 of 80

Comments:

Verified By:	John N. Hamawi	John Hamawi	12/6/04
(First, MI, Last)	Printed / Typed Name	Signature	Date

TABLE OF CONTENTS

1.0 Purpose/Objective

Determine atmospheric dispersion factors (χ/Q's) for accident analyses using Regulatory Guide 1.145 and 1.194 methodologies as requested in Entergy/Pilgrim Contract Order Number 4500534887 (Reference 1).

2.0 Assumptions and Key Assumptions

- The maximum allowable plume centerline height is assumed to be the same as the annual average mixing layer height.
- Gamma χ/Q's were determined using a relative concentration of 1.0 for a single radionuclide, Xe-133. This is a conservative assumption supported by aeolus3 test runs documented in this calculation.
- Distance from the Main Stack and the Turbine Building to the Low Population Zone (LPZ) is assumed to be the same as the distance from the Reactor Building to the LPZ. This is reasonable considering the distance in question (6840 meters).
- Releases from the Reactor Building vent are at a height that is less than 2.5 times the height of adjacent solid structures and are therefore assumed to be ground level releases.
- The Yard release point is assumed to be a ground level release.
- No building wake credit is taken for the Yard release point although plume meander credit is accounted for.
- Releases from the Turbine Building roof are at a height that is less than 2.5 times the height of adjacent solid structures and are therefore assumed to be ground level releases.
- Releases from the Turbine Building roof exhausters are assumed to occur from the roof exhauster that is closest to the receptor locations.
- Releases from the Turbine Building Reactor Feed Pump area roof exhausters are assumed to be funneled to one release location.
- Releases from the Reactor Building Truck Lock are at a height that is less than 2.5 times the height of adjacent solid structures and are therefore assumed to be ground level releases.
- For ground level releases modeled using the computer code aeolus3, terrain heights are not used. (Per Reg. Guide 1.145, release-point and receptor elevations are assumed to be the same.)

A key assumption is any assumption or limitation that must be verified prior to using the results and/or conclusions of a calculation for a safety-related task. There are no key assumptions in the present calculation.

3.0 Design Input

- The meteorological data used in these analyses were obtained from References 5 and 6; they cover a five-year period from 1996 to 2000.[1]
- The wind speed classes used in the aeolus3 computer runs were obtained from Reference 7.
- Distances from the Main Stack, Reactor Building, and Turbine building to the Exclusion Area Boundary (EAB) were determined using References 8, 9, and 10.
- Terrain heights between the Main Stack and the EAB, with respect to the grade at the base of the Main Stack, were determined using Reference 8.
- Plume rise was not allowed even though the SGTS would be on.

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[1] Five years of hourly meteorological data were used because Reg. Guide 1.194 states that a five year period is considered to be reprensentative of long-term trends at most sites. The five year period from 1996 to 2000 was used in order to compare results with a previous calculation performed by PNPS (PNPS-1-ERHS-II.B-3).

- All other design inputs were received from the Pilgrim Nuclear Power Station (Reference 2); the data are presented in Exhibit 1.
- The 0-8 time interval for the LPZ χ/Q's in Reg. Guide 1.145 was conservatively subdivided into two intervals, namely 0-2 and 2-8. The 0-2 interval is more suitable for short term releases than the 0-8 interval.

Wind speed group upper limits (Reference 7)	0.45, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 8.0, 10.0, 13.0, 18.0, >18.0m/sec (use 22.4)

Distances from Release Points to Exclusion Area Boundary[2]
(References 8, 9, 10)

SECTOR (based on True North)	Main Stack Dist.(m)	Reactor Building Dist. (m)*	Turbine Building Dist. (m)*
N	373.2	492	534
NNE	492	486	528
NE	492	486	528
ENE	516	510	558
E	660	585.6	571.2
ESE	801.6	565.2	554.4
SE	540	471.6	415.2
SSE	393.6	350.4	302.4
S	295.2	331.2	279.6
SSW	270	301.2	255.6
SW	270	301.2	255.6
WSW	270	301.2	255.6
W	285.6	320.4	277.2
WNW	310.8	411.6	344.4
NW	310.8	507.6	498
NNW	313.2	511.2	498

* Distances determined from the nearest point on the building to the EAB within a 45-degree sector centered on the compass direction of interest (Reg. Guide 1.145).

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[2] The exclusion zone over water is 500 yards (1500 feet) from the Intake structure head wall. The area would be a roughly rectagular shape runnig from property line to property line, and along the N 11690 grid line of the plant coordinate system (see drawing C2).

SECTOR	Main Stack Terrain Height (m above MS grade) (Reference 8, at EAB distances)*
N	1.5
NNE	1.5
NE	1.5
ENE	1.5
E	1.5
ESE	1.5
SE	1.5
SSE	1.5
S	1.5
SSW	4.6
SW	4.6
WSW	4.6
W	4.6
WNW	0.0
NW	0.0
NNW	0.0

- Terrain heights are the maximum values from the release point grade to receptor.

DESCRIPTION	VALUE
Sensor heights of primary meteorological tower above stack grade	220', 33'
Delta-temperature sensor separation	220'-33' = 187'
Units for all met parameters	ws – mph; wd – degrees from True North; temperature – degrees Fahrenheit; delta-temperature – degrees Fahrenheit per 187'
Main Stack Release Point: grade at stack base	65'
Main Stack Release Point: height above stack base grade	335'
Main Stack Release Point: height of adjacent solid structures	≈15'
Main Stack Accident Flow rate (used in ARCON96 for downwash effect)	4000 scfm
Main Stack diameter	28.75 inches or 0.73 meters
Effective height, MS release point to Control Room intake	335 – (73-65) = 327'
Effective height, MS release point to Technical Support Center intake	335' (intake is below stack grade)
Turbine Building grade elevation	23'
Turbine Building Release Point: elevation	108'
Turbine Building Release Point: release height above grade	85'
Turbine Building Release Point: cross-sectional area for building wake	2116m^2
Turbine Building Reactor Feed Pump Release Point: grade	23'
Turbine Building Reactor Feed Pump Release Point (RFP): elevation	82'
Turbine Building Reactor Feed Pump Release Point: release height	59'
Turbine Building Reactor Feed Pump Release Point: cross-sectional area for building wake	406m^2
Reactor Building Vent Release Point: grade	23'
Reactor Building Vent Release Point: elevation	182'

DESCRIPTION	VALUE
Reactor Building Vent Release Point: release height above grade	159'
Reactor Building elevation for building wake effects	166' (Reference 11)
Reactor Building Vent Release Point: cross-sectional area for building wake	1886m^2
Reactor Building Truck Lock Release Point: grade	23'
Reactor Building Truck Lock Release Point: elevation	43'
Reactor Building Truck Lock Release Point: release height	20'
Reactor Building Truck Lock Release Point: cross-sectional area for building wake	1382m^2
Control Room Receptor: grade elevation	23'
Control Room Receptor: elevation of air intake	73'
Control Room Receptor: distance and direction to Main Stack	800', 303°
Control Room Receptor: distance and direction to Turbine Building roof exhausters	138', 207°
Control Room Receptor: distance and direction to Turbine Building Reactor Feed Pump Area	186', 273°
Control Room Receptor: distance and direction to Reactor Building vent	160', 285°
Control Room Receptor: distance and direction to Reactor Building truck Lock	248', 315°
Control Room Receptor: distance and direction to Reactor Building North Wall	150' (rounded down to 45m in the ARCON96 run), 345°
Technical Support Center Receptor: grade elevation	23'
Technical Support Center Receptor: height of air intake above grade	10'
Technical Support Center Receptor: distance and direction from intake to Main Stack	920', 304°
Technical Support Center Receptor: distance and direction to Turbine Building roof exhausters	190', 256°
Technical Support Center Receptor: distance and direction to Turbine Building RFP	300', 285°
Technical Support Center Receptor: distance and direction to Reactor Building vent	280', 290°
Technical Support Center Receptor: distance and direction to Reactor Building truck Lock	390', 310°
Technical Support Center Receptor: distance and direction to Reactor Building North Wall	240', 325°
Reactor Building North Wall Release Point: grade	23'
Reactor Building North Wall Release Point: release heights above grade	2.0 m
Reactor Building North Wall Release Point: cross-sectional area for building wake	1860m^2
Annual average mixing height	630m
Exclusion area boundary distances and terrain heights	See Drawings, use actual property line north of Rocky Hill Road

DESCRIPTION	VALUE
Yard Area Release Point: release height, receptor height,	0
Yard Area Release Point: receptor height	0
Yard Area Release Point: site boundary/EAB distances from Yard Area	Use circular rings at 10, 50, 100, 200, 300, 400, and 500m
Wind speed to be assigned to calms	0.225 m/sec (0.5 mph)
Distance to LPZ (assumed the same for all release points)	6840m
Main Stack Release Point: LPZ terrain heights above MS grade (feet)	N 0.0 NNE 0.0 NE 0.0 ENE 0.0 E 0.0 ESE 4.6 SE 7.6 SSE 53.3 S 93.0 SSW 102.1 SW 59.4 WSW 59.4 W 41.1 WNW 32.0 NW 7.6 NNW 0.0

4.0 Computing Environment

The computer runs in this calculation involved the use of computer codes aeolus3 and ARCON96 and were carried out on the HP 9000/785 CPU running the HP UX B.10.20 operating system and a Dell Optiplex GX240 (serial number DVKPM11) running the Microsoft Windows XP operating system, respectively. Computer codes aeolus3 and ARCON96 are listed in the Framatome-ANP Computer Software Index. They are safety-related computer codes used to produce atmospheric dispersion factors using the methodologies of Regulatory Guides 1.145 and 1.194, respectively. There are no open software error reports for aeolus3 or ARCON96. The software installation test record for ARCON96 for the present calculation is provided in Attachment D.

5.0 Quality Assurance

This work was performed under Framatome's Quality Assurance Program, and Framatome Procedure 0402-01 (Preparing and Processing FANP Calculations) was followed.

6.0 Calculations

Meteorological data recorded by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station from January 1996 through December 2000 and evaluated in Reference 5 were used in determing the χ/Q's. These data were reformatted for use with computer code ARCON96 in Reference 6.

Input requirements for the aeolus3 computer code are provided in Attachment A. Inputs for all aeolus3 runs are provided in Attachment B. Input/output for all ARCON96 runs are provided in Attachment E.

The input and output files have been stored on the FANP COLD server for archival storage and written to a compact disc for PNPS. A listing of the file names is provided in Attachment C.
Other cases were included for informational purposes and potential future use.

7.0 Results/Conclusion

The following tables present atmospheric dispersion factors (χ/Q's) determined using Regulatory Guide 1.145 and 1.194 methodologies, as implemented in computer codes aeolus3 and ARCON96 respectively, which are suitable for use in accident analyses. The appropriate Main Stack to Control Room and Main Stack to Technical Support Center χ/Q's for use in radiological habitability analyses are presented in Tables 7.8 and 7.9.

Note that the χ/Q's for MS to the CR and TSC (in Tables 7.1 and 7.2) are for direct transfer from the stack to the respective air intakes. They do not include the contributions of recirculation effects as specified in Reg. Guide 1.194. The applicable logic from this guide is as follows:

- The maximum non-fumigation X /Q value obtained for the 0-2 hour interval using aeolus3, which implements the Reg .Guide 1.145 methodology, was compared to the corresponding value obtained using the ARCON96 methodology, and the higher value was selected for use in habitability assessments,
- The X /Q values obtained using the ARCON96 methodology for the 2-8 hour and 8-24 hour intervals are the values to be used in habitability assessments,
- For the remaining time intervals (namely, 24-96 and 96-720 hours), a weighted average of the X /Q values obtained using both methodologies are the values to be used in habitability assessments.

The equation used to perform the weighted average for each interval is:

$$\chi/Q=[1*(\chi/Q)_{RG1.145}+23*(\chi/Q)_{ARCON96}]/24$$

The appropriate MS to CR and TSC χ/Q's for use in radiological habitability analyses are presented in Tables 7.8 and 7.9 under the heading RG 1.194.

Table 7.1: Control Room Atmospheric Dispersion Factors (Concentration χ/Q) From ARCON96

To →	Control Room					
From →	Main Stack*	Turbine Building	TB Reactor Feed Pump Area	Reactor Building Vent	Reactor Building Truck Lock	Reactor Building North Wall
Time Interval	(s/m^3)	(s/m^3)	(s/m^3)	(s/m^3)	(s/m^3)	(s/m^3)
0 – 2 hours	4.01E-07	3.56E-03	1.99E-03	1.76E-03	9.72E-04	2.36E-03
2 – 8 hours	3.02E-07	3.11E-03	1.69E-03	1.25E-03	7.52E-04	1.60E-03
8 – 24 hours	6.18E-08	1.26E-03	6.67E-04	4.26E-04	2.80E-04	6.10E-04
1 – 4 days	5.89E-08	1.10E-03	5.17E-04	3.67E-04	1.93E-04	4.37E-04
4 – 30 days	5.05E-08	9.52E-04	4.67E-04	3.15E-04	1.61E-04	3.51E-04

* These χ/Q's are not to be used as-is for radiological habitability analyses per Reg. Guide 1.194; see Table 7.8.

Table 7.2: Technical Support Center Atmospheric Dispersion Factors (Concentration χ/Q) From ARCON96

To →	Technical Support Center					
From →	Main Stack*	Turbine Building	TB Reactor Feed Pump Area	Reactor Building Vent	Reactor Building Truck Lock	Reactor Building North Wall
Time Interval	(s/m^3)	(s/m^3)	(s/m^3)	(s/m^3)	(s/m^3)	(s/m^3)
0 – 2 hours	5.14E-07	1.72E-03	7.73E-04	6.94E-04	4.27E-04	1.04E-03
2 – 8 hours	3.85E-07	1.54E-03	6.40E-04	4.91E-04	3.45E-04	7.44E-04
8 – 24 hours	8.04E-08	5.67E-04	2.55E-04	1.67E-04	1.27E-04	2.83E-04
1 – 4 days	7.48E-08	4.96E-04	1.86E-04	1.41E-04	9.13E-05	1.85E-04
4 – 30 days	6.46E-08	4.10E-04	1.69E-04	1.22E-04	7.39E-05	1.63E-04

* These χ/Q's are not to be used as-is for radiological habitability analyses per Reg. Guide 1.194; see Table 7.9.

Table 7.3: EAB/LPZ Atmospheric Dispersion Factors for Main Stack Releases From aeolus3

Receptor	Time Interval (hours)	Concentration χ/Q (s/m^3)	Critical Sector	Distance (m) from MS	Gamma** χ/Q (s/m^3)	Sector	Distance (m) from MS
EAB	Fumigation	1.820E-04	SSW	270.0	9.960E-05	SSW	270.0
	0 – 2	2.812E-06	SSE	393.6	7.390E-06	WNW	310.8
LPZ	Fumigation	1.908E-05	S	6840.0	1.503E-05	SSE	6840.0
	0 – 2	4.541E-06	SSW	6840.0	6.248E-06	WNW	6840.0
	2 – 8	2.258E-06	SSW	6840.0	2.943E-06	WNW	6840.0
	8 – 24	1.210E-06	SSW	6840.0	1.502E-06	WNW	6840.0
	24 – 96	4.651E-07	SSW	6840.0	5.534E-07	*	6840.0
	96 - 720	1.178E-07	SSW	6840.0	1.361E-07	*	6840.0

* Direction-independent (all sectors combined)

** Comparison of the aeolus3 outputs from cases mstoeab and mstoeab2, and cases mstolpz and mstolpz2 shows that Xe133 leads to higher gamma χ/Q's than 0.2MeV, with the exception of the EAB 0 – 2 hour value. The listed value in the table is for Xe133; the value for 0.2 MeV is 8.632E-06.

Table 7.4: EAB/LPZ Atmospheric Dispersion Factors for Turbine Building Releases From aeolus3

Receptor	Time Interval (hours)	Concentration χ/Q (s/m^3)	Critical Sector	Distance (m) from TB	Gamma χ/Q (s/m^3)	Sector	Distance (m) from TB
EAB	0 – 2	8.631E-04	WSW	255.6	3.234E-04	NE	528.0
LPZ	0 – 2	3.692E-05	NE	6840.0	3.706E-05	NE	6840.0
	2 – 8	1.929E-05	NE	6840.0	1.856E-05	NE	6840.0
	8 – 24	1.080E-05	NE	6840.0	1.001E-05	NE	6840.0
	24 – 96	4.441E-06	NE	6840.0	3.885E-06	NE	6840.0
	96 - 720	1.239E-06	NE	6840.0	9.978E-07	NE	6840.0

Table 7.5: EAB/LPZ Atmospheric Dispersion Factors for Reactor Building Releases From aeolus3

Receptor	Time Interval (hours)	Concentration χ/Q (s/m^3)	Critical Sector	Distance (m) from TB	Gamma χ/Q (s/m^3)	Sector	Distance (m) from TB
EAB	0 – 2	7.479E-04	NE	486.0	3.199E-04	NE	486.0
LPZ	0 – 2	3.692E-05	NE	6840.0	3.551E-05	NE	6840.0
	2 – 8	1.915E-05	NE	6840.0	1.782E-05	NE	6840.0
	8 – 24	1.066E-05	NE	6840.0	9.627E-06	NE	6840.0
	24 – 96	4.339E-06	NE	6840.0	3.745E-06	NE	6840.0
	96 – 720	1.194E-06	NE	6840.0	9.656E-07	NE	6840.0

Table 7.6: Maximum Offsite Atmospheric Dispersion Factors for Main Stack Releases From aeolus3 (CR Case)

Receptor Distance (m)	Time Interval (hours)	Concentration χ/Q (s/m^3)
400	0 – 2	3.926E-06
400	2 – 8	2.203E-06
400	8 – 24	1.316E-06
400	24 – 96	5.966E-07
400	96 - 720	1.926E-07

Table 7.7: Maximum Offsite Atmospheric Dispersion Factors for Main Stack Releases From aeolus3 (TSC Case)

Receptor Distance (m)	Time Interval (hours)	Concentration χ/Q (s/m^3)
400	0 – 2	3.681E-06
400	2 – 8	2.069E-06
400	8 – 24	1.237E-06
400	24 – 96	5.622E-07
400	96 - 720	1.828E-07

Table 7.8: Control Room Atmospheric Dispersion Factors (Concentration χ/Q) for Main Stack Releases (Reg. Guide 1.194)

ARCON96			aeolus3		**RG 1.194**
Time Interval	X/Q (sec/m3) From Table 7.1		X/Q (sec/m3) From Table 7.6		**X/Q (sec/m3)**
0-2 hours	4.01E-07		3.93E-06		**3.93E-06**
2-8 hours	3.02E-07		2.20E-06*		**3.02E-07**
8 to 24 hours	6.18E-08		1.32E-06*		**6.18E-08**
24-96 hours	5.89E-08		5.97E-07		**8.13E-08**
96-720 hours	5.05E-08		1.93E-07		**5.64E-08**

* Not applicable

Table 7.9: Technical Support Center Atmospheric Dispersion Factors (Concentration χ/Q) for Main Stack Releases (Reg. Guide 1.194)

ARCON96			aeolus3		**RG 1.194**
Time Interval	X/Q (sec/m3) From Table 7.2		X/Q (sec/m3) From Table 7.7		**X/Q (sec/m3)**
0-2 hours	5.14E-07		3.68E-06		**3.68E-06**
2-8 hours	3.85E-07		2.07E-06*		**3.85E-07**
8 to 24 hours	8.04E-08		1.24E-06*		**8.04E-08**
24-96 hours	7.48E-08		5.62E-07		**9.51E-08**
96-720 hours	6.46E-08		1.83E-07		**6.95E-08**

* Not applicable

Table 7.10: Worst Sector Atmospheric Dispersion Factors (Concentration χ/Q) for Yard Area Releases From aeolus3

Receptor Distance (m)	0 – 2 hours (sec/m3)	2 – 8 hours (sec/m3)	8 – 24 hours (sec/m3)	24 – 96 hours (sec/m3)	96 – 720 hours (sec/m3)
10	7.713E-01	4.883E-01	3.247E-01	1.737E-01	7.072E-02
50	4.208E-02	2.653E-02	1.757E-02	9.342E-03	3.771E-03
100	1.232E-02	7.725E-03	5.093E-03	2.689E-03	1.075E-03
200	3.493E-03	2.189E-03	1.443E-03	7.610E-04	3.038E-04
300	1.757E-03	1.096E-03	7.190E-04	3.767E-04	1.490E-04
400	1.088E-03	6.757E-04	4.417E-04	2.302E-04	9.029E-05
500	7.485E-04	4.633E-04	3.019E-04	1.566E-04	6.098E-05

Table 7.11: Worst Sector Atmospheric Dispersion Factors (Gamma χ/Q) for Yard Area Releases From aeolus3

Receptor Distance (m)	0 – 2 hours (sec/m3)	2 – 8 hours (sec/m3)	8 – 24 hours (sec/m3)	24 – 96 hours (sec/m3)	96 – 720 hours (sec/m3)
10	5.653E-03	3.504E-03	2.298E-03	1.217E-03	4.897E-04
50	2.603E-03	1.630E-03	1.073E-03	5.656E-04	2.254E-04
100	1.629E-03	9.923E-04	6.374E-04	3.233E-04	1.220E-04
200	9.388E-04	5.547E-04	3.468E-04	1.688E-04	6.000E-05
300	6.960E-04	4.017E-04	2.459E-04	1.158E-04	3.932E-05
400	5.629E-04	3.191E-04	1.923E-04	8.841E-05	2.898E-05
500	4.610E-04	2.588E-04	1.546E-04	7.014E-05	2.255E-05

8.0 References

1. Entergy/Pilgrim Contract Order Number 4500534887.
2. Entergy Nuclear Generation Company, Pilgrim Nuclear Power Station letter NESG 04-098, October 27, 2004.
3. U.S. Nuclear Regulatory Commission Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants", Revision 1, November 1982.

4. U.S. Nuclear Regulatory Commission Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants", June 2003.
5. AREVA/FANP Calculation 32-5052036-00, "Evaluation of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data", dated November 2004.
6. AREVA/FANP Calculation 32-5052125-00, "Conversion of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data for Use With ARCON96", dated November 2004.
7. ANSI/ANS-2.5-1984, American National Standard for Determining Meteorological Information at Nuclear Power Sites, dated September 14, 1984.
8. PNPS Drawing C-2, Rev. E9, Site Plan, April 2000.
9. PNPS Drawing C-1, Rev. E2, Site Plan, 3-15-79.
10. PNPS Drawing A-105, Rev. 2, Access Control & Radiation Zones General Station Yard Areas Operation & Shut Down, 8-24-73.
11. PNPS Drawing A-16, Rev. E3, Turbine and Rector Buildings North & South Elevations, 11/95.

Exhibit 1: Design Input Data Transmitted by PNPS

Entergy

Entergy Nuclear Generation Company
Pilgrim Nuclear Power Station
[illegible]
[illegible]

October 27, 2004
NESG 04-098

Richard J. Cacciapouti
Manager, Nuclear & Radiation Engineering
Framatome ANP, Inc.
400 Donald Lynch Boulevard
Marlborough, MA 01752

Dear Mr. Cacciapouti:

The following information is to be used by Framatome ANP in support of Pilgrim Station Fuel Handling Accident calculations. See Attachment 2 below.

My only concern with these design inputs is that physical lengths are expressed in feet and meters. This is due to the reference documents that support the values. Having a mixture of units is a potential error trap. I caution you and your staff to be highly sensitized to this observation.

Should you have any questions, please call me directly at 508-830-7832.

Sincerely Yours,

Fred J. Mogolesko
Dr. Fred J. Mogolesko
Senior Project Manager

Attachment

FJM:jmp

Attachment 2

PNPS MET DATA AND X/Q - DESIGN INPUT

No.	DESCRIPTION	VALUE	REFERENCE
	A - Met Data		
A1	Sensor heights for 220 foot meteorological tower	220ft, 33ft	2. Page B-1 and B-168
A2	Delta-temperature sensor separation	220ft -33ft	2. Page B-2
A3	Units for all met parameters	WS – mph; WD – degrees from True North; temperature – degrees Fahrenheit; delta-temperature – degrees Fahrenheit per 187ft	NA –Standard Units
	B - ARCON96 Inputs		
B1	Main Stack Release Point: grade at stack base	65ft	1
B2	Main Stack Release Point: height above stack base grade	335ft	2, App. B, page B-15
B3	Main Stack Release Point: height of adjacent solid structures	15ft	1
B4	Turbine Building grade elevation	23ft	10
B5	Turbine Building Release Point: elevation	108ft	10
B6	*Turbine Building Release Point: release height*	*85ft*	*10*
B7	Turbine Building Release Point: cross-sectional area for building wake	2116m^2	5, 10
B8	Turbine Building Reactor Feed Pump Release Point: grade	23ft	10
B9	Turbine Building Reactor Feed Pump Release Point: elevation	82ft	10
B10	Turbine Building Reactor Feed Pump Release Point: release height	59ft	10
B11	Turbine Building Reactor Feed Pump Release Point: cross-sectional area for building wake	406m^2	5, 10
B12	Reactor Building Vent Release Point: grade	23ft	9
B13	Reactor Building Vent Release Point: elevation	182ft	8
B14	Reactor Building Vent Release Point: release height	159ft	8, 9
B15	Reactor Building Vent Release Point: cross-sectional area for building wake	1686m^2	7, 9
B16	Reactor Building Trucklock Release Point: grade	23'	9
B17	Reactor Building Trucklock Release Point: elevation	43'	8
B18	Reactor Building Trucklock Release Point: release height	20'	8, 9

B19	*Reactor Building Trucklock Release Point: cross-sectional* area for building wake	1382m^2	7, 9
B20	Control Room Receptor: grade elevation	23ft	8
B21	Control Room Receptor: elevation of air intake	73ft	6, 11
B22	Control Room Receptor: distance and direction to Main Stack	800ft, 303°	12
B23	Control Room Receptor: distance and direction to Turbine Building roof exhausters	138ft, 207°	13
B24	*Control Room Receptor: distance and direction to Turbine* Building Reactor Feed Pump Area	186ft, 273°	12, 13
B25	Control Room Receptor: distance and direction to Reactor Building vent	160ft, 285°	12, 13
B26	Control Room Receptor: distance and direction to Reactor Building trucklock	248ft, 315°	6, 12, 13
B27	Control Room Receptor: distance and direction to Reactor Building North Wall	150ft, 345°	6, 13
B28	*Technical Support Center Receptor: grade elevation*	23ft	12
B29	Technical Support Center Receptor: elevation of air intake	10ft	14
B30	Technical Support Center Receptor: distance and direction from intake to Main Stack	920ft, 304°	12
B31	Technical Support Center Receptor: distance and direction to Turbine Building roof exhausters	190ft, 256°	12
B32	Technical Support Center Receptor: distance and direction to Turbine Building RFP	280ft, 290°	12
B33	Technical Support Center Receptor: distance and direction to Reactor Building vent	300ft, 285°	12
B34	Technical Support Center Receptor: distance and direction to Reactor Building trucklock	390ft, 310°	12
B35	Technical Support Center Receptor: distance and direction to Reactor Building North Wall	240ft, 325°	12
B36	Reactor Building North Wall Release Point: grade	23ft	9
B37	Reactor Building North Wall Release Point: elevation at top of RB	166ft	11
B38	Reactor Building North Wall Release Point: release heights	2.0 m	Assumed
B39	Reactor Building North Wall Release Point: cross-sectional area for building wake	1860m^2	9, 11, 13

C - AEOLUS3 Inputs			
C1	Annual average mixing height	630m	2, Table B.2-14
C2	Exclusion area boundary distances and terrain heights	See Drawings, use actual property line north of Rocky Hill Road	12, 15, 16
C3	Over Water Distance to Exclusion Zone	The exclusion zone over water is 500 yards (1500 feet) from the Intake structure head wall. The area would be a roughly rectangular shape from property line to property line. On the E size drawing C2 the 1500 feet would be about 1-7/8 inches off the N 11500 line.	
C4	Yard Area Release Point: release height, receptor height,	0	Release ht of 0 is typical for ground level release
C5	Yard Area Release Point: receptor height	0	Receptor height is assumed to be 0
C6	Yard Area Release Point: site boundary/EAB distances from Yard Area	Use circular rings at 10, 50, 100, 200, 300, 400, and 500m	Assumption
C7	Wind speed to be assigned to calms	0 225 m/sec	4
C8	Distance to LPZ (assumed the same for all release points)	6840m	3
C9	Main Stack Release Point: LPZ terrain heights above MS grade (feet)	0.0 0.0 0.0 0.0 0.0 4.6 7.6 53.3 93.0 102.1 59.4 59.4 41.1 32.0 7.6 0.0	2, Table B.3-1

Addendum:
Main Stack Accident Flow rate 4000 acfm (Reference 17)
Main Stack diameter 28.75 inches or 0.73 meters (Reference 18)

REFERENCES

1. PNPS Drawing M28, Equipment Location Main Stack & Filter Building.
2. Pilgrim Station Unit 1 Appendix I Evaluation, April 1977.
3. PNPS Final Safety Analysis Report, Chapter 14, Table 14.5-2, Revision 15, June 1993.
4. Manual PNPS-1-ERHS-XIX.Q-54, Revision 0, "RCP User's Manual For Program AEOLUS-3", S&SACP-29, Revision 0, Software Catalog Item #01379.
5. PNPS Drawing M14, Equipment Location Turbine Building Plan El. 51'-0"
6. PNPS Drawing M18, Equipment Location Reactor Building Plan El. 51'-0"
7. PNPS Drawing M19, Equipment Location Reactor Building Plan El. 74'-3" & El. 91'-3"
8. PNPS Drawing M22, Equipment Location Reactor Building Section C–C
9. PNPS Drawing M23, Equipment Location Section D-D Y L-L
10. PNPS Drawing M24, Equipment Location Sections: E-E and F-F.
11. PNPS Drawing M26, Equipment Location Sections: H-H, J-J, & K-K.
12. PNPS Drawing C2, Rev. E9, Site Plan.
13. PNPS Drawing A6, Turbine and Reactor Building Roof Plan.
14. PNPS Drawing M646, Technical Support Center Mechanical Floor Plan.
15. PNPS Drawing C1, Rev. E2, Site Plan.
16. PNPS Drawing A-105, Rev. 2, Access Control & Radiation Zones General Station Yard Areas Operation & Shut Down.
17. PNPS Drawing M-289, Reactor Building Air Flow Diagram.
18. PNPS Unit 1 Appendix I Evaluation, April 1977.

ATTACHMENT A: INPUT REQUIREMENTS FOR AEOLUS3

AEOLUS3 MOD 01 Input Data Requirements Plant and Receptor Data

Input Line 1 (20A4)

Col. 1-80 TITLE Any alphanumeric characters for problem identification.

Input Line 2 (16I5) Program control options

Col. 5 KOPT Application option, as follows:

(a) 1 = Continuous, routine releases
(b) 2 = Intermittent releases
(c) 3 = Accidental releases

Col. 10 KPRINT Printout control option, as follows:

(a) 0 = Short printout (which includes the input data and final summaries)

(b) 1 = Full printout along with intermediate results

See also KPRMET in Input Line 12 and KPRT in Input Line 24B.

Col. 14-15 KMN Plume meander control option, as follows:

(a) -1 = Activate the Murphy and Campe building wake correction model (see parameter CONDIA in Input Line 5)

(b) 0 = Exclude plume meander consideration in the plume centerline concentration X/Q

(c) 1 = Include plume meander consideration in the plume centerline concentration X/Q

Col. 20 KCF Control option for recirculation correction, as follows:

(a) 0 = No correction

(b) 1 = Open terrain recirculation correction factors in Reg. Guide 1.111 (Ref. 2, Rev. 0), as built in AEOLUS-3

(c) 2 = User-supplied correction factors via Input Line Set 24

Defaults to 2 for valleys (i.e., if KVORS<0 in Col. 39-40)

Col. 25 KWEXP Wind-speed extrapolation control option, as follows:

(a) 0 = No extrapolation of wind speed with height (i.e. input wind speeds will be assumed to apply also at the point of release)

(b) 1 = The following built in extrapolation:

Stabilities A, B, C, D : 0.25

		Stabilities E, F, G : 0.50
		(c) 2 = User-supplied coefficients, as described in Input Line 4
Col. 30	KGX	Gamma (X/Q) control option, as follows: (a) 0 = Bypass this calculation (b) 1 = Include this calculation
Col. 35	KSIG	*Model-selection control option for the dispersion coefficients σ_y and σ_z, as follows:* (a) 0 = ENTECH's model with parabolic interpolation (b) 1 = Eimutis/Konicek model in XOQDOQ
Col. 39-40	KVORS	Sea breeze/Valley model option selection, as follows: (a) -1 = Valley analysis (b) 0 = Open terrain analysis (c) 1 = Sea breeze analysis
Col. 44-45	KDEPL	Depletion model control option: (a) -1 = Single deposition-velocity value for all stabilities and wind speeds (see Input Line 10A) (b) 0 = Reg. Guide 1.111 (Ref. 2, Rev. 1) depletion and deposition curves (c) >0 = Model in Meteorology & Atomic Energy (Ref. 6), with KDELP = number of wind speeds in the WSDEP and VUDEP arrays in Input Lines 10B through 10X (max=12)
Col. 50	KRAIN	Wet deposition control option, as follows: (a) 0 = Do not evaluate wet deposition effects (b) 1 = *Evaluate wet deposition effects*
Col. 55	NWSIN	Number of wind speed groups (max 12) (see Line Set 3)
Col. 60	NEG	Number of gamma energy groups in the user- specified spectrum, if any (max 16). Set NEG = 0 if Input Line Set 9 is provided, or if KGX = 0.
Col. 61-65	INTERM	Duration of intermittent releases (hours). Leave blank for the analysis of continuous or accidental releases. Set INTERM = total number of hours (not necessarily consecutive) during which intermittent releases took place, during the entire time interval represented by *the joint-frequency distribution; for multi-year runs enter the annual worst-year total.*
Col. 66-70	IPCT	Hourly value exceedance probability for intermittent releases (percent). Leave blank for continuous or accidental releases. Set equal to 1, 3, 5, 10, 15, 20, 25, 30, 35, 40, 45 or 50 for intermittent releases. Defaults to 15 if not provided, or if the selected value is greater than 50. IPCT = 2 defaults to IPCT = 1, and any value greater than 3 defaults to the nearest entry in the above list.
Col. 74-75	NMONTH	Number of monthly records in the met data base which will be analyzed (maximum 240, for 20 years)

Col. 80	KTP7	Control option for transferring information to tape7 (YODA inputs) as follows (Note: Tape7 is generated only if KOPT▯2): (a) 1 = Sector, distance, description/pathway, sector-average undepleted and undecayed concentration X/Q, sector-average depleted and decayed concentration X/Q, sector-average D/Q, and sector-average undecayed and undepleted gamma X/Q (b) 2 = Sector, distance, description/pathway, plume centerline undepleted and undecayed concentration X/Q, plume centerline depleted and decayed concentration X/Q, plume centerline D/Q, and plume centerline undecayed and undepleted gamma X/Q If not supplied, default value is KTP7=1.
<u>Input Line Set 3</u>	Wind speed group definition (See notes under WSLIM(2) and WSLIM(NWSIN+1))	
<u>Input Line 3A (8E103)</u>		
Col. 1-10	WSLIM(2)	Upper wind speed (m/sec) in the first wind speed group. Enter here the minimum wind speed acceptable as a valid observation (m/sec), corresponding to the anemometer or wind vane starting speed, whichever is larger. Hourly observations with wind speed less than WSLIM(2) will be classified as calms with a wind speed defined by parameter WSCALM in Input Line 14) (Note: WSLIM(1) is internally defined as 0.0)
Col. 11-20	WSLIM(3)	Upper wind speed (m/sec) in the second wind speed group (Note: All hourly wind speeds WS in the range WSLIM(2) < WS ≤ WSLIM(3) will be assigned to this group)
⋮		
Col. 71-80	WSLIM(9)	Upper wind speed for the eighth wind speed group (may be left blank)
<u>Input Line 3B</u> (8E10.3)	Omit this Input Line if NWSIN in Input Line 2 is less than 9.	
Col. 1-10	WSLIM(10)	Upper wind-speed of the ninth wind speed group
⋮		
	WSLIM(NWSIN + 1)	Upper wind-speed of the last wind-speed group (Note: this entry should correspond to the maximum wind-speed acceptable as a valid observation, i.e., to parameter WSMAX defined in Input Line 13, after conversion to the same units)
<u>Input Line 4</u> (8E10.3)	Wind-speed extrapolation data. Include this Input Line only if KWEXP = 2 (in Input Line 2). Default values for KWEXP = 1, are shown in parentheses.	
Col. 1-10	WSEXP(1)	Wind-speed extrapolation coefficient for atmospheric stability A, in the form: $u(new) = u(old)*[h(new)/h(old)]^{WSEXP}$ h(new) is internally set equal to 10 m for the ground-level wind speed, and to HREL (in Input Line 5) for the wind speed at the release point. WSEXP(1) defaults to 0.25 if KWEXP=1.
Col. 11-20	WSEXP(2)	Coef. for stability B (0.25)
Col. 21-30	WSEXP(3)	Coef. for stability C (0.25)

Col. 31-40	WSEXP(4)	Coef. for stability D (0.25)
Col. 41-50	WSEXP(5)	Coef. for stability E (0.50)
Col. 51-60	WSEXP(6)	Coef. for stability F (0.50)
Col. 61-70	WSEXP(7)	Coef. for stability G (0.50)
<u>Input Line 5</u> (8E10.3)	Release-point data	
Col. 1-10	HREL	Height of release (m above release point grade)
Col. 11-20	HBLD	Height of building adjacent to the release point (m above release-point grade)
Col. 21-30	BAREA	Cross-sectional area of building adjacent to the release point causing building wake effects (m^2)
Col. 31-40	DIAMTR	Effluent vent effective internal diameter (m). Set DIAMTR = 0 for ground-level releases (HREL = 0), or for bypassing plume rise effects in elevated releases.
Col. 41-50	VFLOW	Effluent vent flow (scfm). Set VFLOW = 0 for ground-level releases, or for bypassing plume rise effects in elevated releases. Vent flow and exit velocity (EXITV) are related as follows: $\text{VFLOW(scfm)} = 1664.18 * \text{EXITV(m/sec)} * \text{DIAMTR(m)}^2$
Col. 51-60	QH	Stack effluent heat content (cal/sec) (if >0 only buoyant plume rise will be calculated)
Col. 61-70	CONDIA	Equivalent diameter (m) of building causing wake effects (for use in conjunction with the Murphy and Campe building wake model, as described in Sec. 4.1.10 of the technical manual) (Defaults to 0.0 if KMN $\geq$ 0 in Input Line 2)
Col. 71-80	RVUSER	Value of Rv (vent exit velocity to wind speed ratio) for the definition of plume entrainment, in lieu of the built-in Reg. Guide 1.111 model. A plume will be totally elevated ($E_t = 0$) if Rv $\geq$ RVUSER, and at ground level ($E_t = 1$) otherwise. Set RVUSER = 0 for the Reg. Guide model with partial entrainment.
<u>Input Line 6</u> (8E10.3)	General site data	
Col. 1-10	HINV	Annual average height of inversion layer at the selected site (m above receptor grade) (see Ref. 5); defaults to 1000 m if not provided.
Col. 11-20	HFMX	Maximum allowable plume centerline height (m above receptor grade) (defaults to HINV if not provided)
Col. 21-30	THLFNG	Noble gas half-life for decay-in-transit analysis (days). Typically set equal to 2.26 days for Xe133m. Enter 0 for no decay.
Col. 31-40	THLFIO	Iodine half-life for decay-in-transit analysis (days). Typically set equal to 8 days for I131. Enter 0 for no decay.
Col. 41-50	SCAVCF(1)	User-specified coefficient for scavenging rate due to rainfall, based on the equation: $\text{Scavenging rate (1/sec)} = \text{SCAVCF(1)} * (\text{Rainfall rate (mm/hr)})^{\text{SCAVCF(2)}}$

		Leave blank if KRAIN=0 in Input Line 2.
Col. 51-60	SCAVCF(2)	Second coefficient for the scavenging rate equation, as defined above.
<u>Input Line Set 7</u>	Gamma energy spectra for the gamma X/Q's. Omit this input line set if KGX = 0, or if NEG = 0, in Input Line 2	
<u>Input Line 7A</u> (8E10.3)		
Col. 1-10	ENGIN(1)	Midpoint energy of the first group in the gamma spectrum associated with the released radioactivity (MeV)
.		
.		
Col. 71-80	ENGIN(8)	Midpoint energy of the 8th group in the spectrum (if any)
<u>Input Line 7B</u> (8E10.3)	Omit this input line if NEG<9	
Col. 1-10	ENGIN(9)	Midpoint energy of the 9th group in the gamma spectrum associated with the released radioactivity (MeV)
.		
.		
Col. —	ENGIN(NEG)	Midpoint energy of the last group in the spectrum
<u>Input Line Set 8</u>	Gamma energy spectra for the gamma X/Q's. Omit this input line set if KGX = 0, or if NEG = 0 in Input Line 2. Note: ABUND(i), where i=1 to NEG, will be ignored if it is less than (1/10,000)th of the ABUND sum.	
<u>Input Line 8A</u> (8E10.3)		
Col. 1-10	ABUND(1)	Relative intensity of first group in the gamma spectrum corresponding to ENGIN (1) (in terms of MeV/sec).
.		
.		
Col. 71-80	ABUND(8)	Relative intensity of 8th group in the spectrum
<u>Input Line 8B</u> (8E10.3)	Omit this input line if NEG<9	
Col. 1-10	ABUND(9)	Relative intensity of 9th group in the gamma spectrum corresponding to ENGIN (9)
.		
.		
Col. —	ABUND(NEG)	Relative intensity of last group in the spectrum
<u>Input Line Set 9</u>	Release isotopics for the gamma X/Q's. Omit this input line set if KGX = 0, or if NEG > 0 (in Input Line 2)	
<u>Input Line 9A</u> (8E10.3)		
Col. 1-10	CONC(1)	Br-83 relative concentration in the effluent vent, or relative release rate
Col. 11-20	CONC(2)	Br-84 relative concentration
Col. 21-30	CONC(3)	Br-85 relative concentration

Col. 31-40	CONC(4)	Br-88 relative concentration
Col. 41-50	CONC(5)	Kr-83m relative concentration
Col. 51-60	CONC(6)	Kr-85m relative concentration
Col. 61-70	CONC(7)	Kr-85 relative concentration
Col. 71-80	CONC(8)	Kr-87 relative concentration

Input Line 9B (8E10.3)

Col. 1-10	CONC(9)	Kr-88 relative concentration
Col. 11-20	CONC(10)	Kr-89 relative concentration
Col. 21-30	CONC(11)	Kr-90 relative concentration
Col. 31-40	CONC(12)	I-129 relative concentration
Col. 41-50	CONC(13)	I-130 relative concentration
Col. 51-60	CONC(14)	I-131 relative concentration
Col. 61-70	CONC(15)	I-132 relative concentration
Col. 71-80	CONC(16)	I-133 relative concentration

Input Line 9C (8E10.3)

Col. 1-10	CONC(17)	I-134 relative concentration
Col. 11-20	CONC(18)	I-135 relative concentration
Col. 21-30	CONC(19)	I-136 relative concentration
Col. 31-40	CONC(20)	Xe-131m relative concentration
Col. 41-50	CONC(21)	XE-133m relative concentration
Col. 51-60	CONC(22)	Xe-133 relative concentration
Col. 61-70	CONC(23)	Xe-135m relative concentration
Col. 71-80	CONC(24)	Xe-135 relative concentration

Input Line 9D

Col. 1-10	CONC(25)	Xe-137 relative concentration
Col. 11-20	CONC(26)	Xe-138 relative concentration
Col. 21-30	CONC(27)	Ar-41 relative concentration
Col. 31-40	CONC(28)	N-13 relative concentration

Input Line Set 10 — Deposition velocity/atmospheric stability correlations. Omit this input line if KDEPL=0 in Input Line 2; enter Input Line 10A if KDEPL<0; otherwise enter n input lines, where n = KDEPL, using Input Lines 10B through 10X.

Input Line 10A (8E10.3) — Omit this input line if KDEPL $\geq$ 0

Col. 1-10	DEPV	*Single deposition-velocity value, for use in conjunction with all wind speeds and all* atmospheric stabilities (m/sec)

Input Lines 10B - 10X — Omit these input lines if KDEPL $\leq$ 0. For KDEPL>2, AEOLUS3 applies parabolic interpolation to the WSDEP and VUDEP data provided in Input Lines 10B - 10X to compute stability and wind-speed dependent deposition velocities corresponding to the average wind speed calculated for each stability and wind speed group combination. If KDEPL = 2, the interpolation applied reduces to linear. If the (deposition velocity/wind speed) ratios are stability dependent but independent of wind speed, set KDEPL = 1, along with any value for WSDEP(1).

Input Line 10B (8E10.3) — First wind speed of interest

Col. 1-10	WSDEP(1)	Wind speed (m/sec)
Col. 11-20	VUDEP(1,1)	(Deposition velocity/wind speed) ratio for Pasquill stability A
Col. 21-30	VUDEP(1,2)	Ratio for stability B
•		
•		
Col. 71-80	VUDEP(1,7)	Ratio for stability G

Input Line 10C (8E10.3) — Second wind speed of interest (if any) (See Input Line 10B for details)

•

•

Input Line 10X (8E10.3) — Last wind speed of interest, where X stands for the (KDEPL+1)'th sequential letter in the alphabet

Input Line 11 (A80) — Meteorological data input format for the 9 parameters defined in Input Line 12 below

Col. 1-80	IMT	Met. data input format for the 9 parameters. Example: (5X,9F5.0)

Note:

(a) Use only one set of parentheses

(b) Use only F formats; e.g., use F2.0 to read a 2-digit integer

(c) You must specify the formats for 9 parameters, even though the data base may contain less or more; read blank fields for parameters not available

(d) If the meteorological data files do not contain any decimals, then the F fields must be specified correctly. For instance, if the number 123 is the wind speed entry and corresponds to a measured wind speed of 12.3 mph., read it using the format F3.1, where the 3 is equal to the total number of digits and 1 is equal to the number of digits to the right of the decimal point; if the measured wind speed is 1.23 mph., then use the format F3.2.

Input Line 12 (11I5) — Meteorological data sequence numbers in IMT (enter 0 or blank for any parameter that is not available)

Col. 5	ID(1)	Sequence number of "year" in IMT

Col. 10	ID(2)	Sequence number of "month"
Col. 15	ID(3)	Sequence number of "day"
Col. 20	ID(4)	Sequence number of "hour"
Col. 25	ID(5)	Sequence number of "wind direction"
Col. 30	ID(6)	Sequence number of "wind speed"
Col. 35	ID(7)	Sequence number of "temperature difference"
Col. 40	ID(8)	Sequence number of "solar radiation". Defaults to 0 if KVORS ≤ 0 in Input Line 2
Col. 45	ID(9)	Sequence number of "precipitation". Defaults to 0 if KRAIN=0 in Input Line 2
Col. 49-50	KPRMET	Printout control option for the hourly met data, as follows: (a) 0 = Do not include the hourly met data in the printout (b) 1 = Include all hourly met data in the printout (c) 2-24 = Print the first KPRMET entries in each month (d) >24 = Print only every KPRMET'th entry in each month KPRMET is not affected by the value selected for KPRINT in Input Line 2. (Recommended value is 2 or 3. Caution: Colossal output may result with KPRMET=1)
Col. 55	KPRJFD	Printout control option for the joint frequency distributions, as follows: (a) 0 = Do not include the joint frequency distributions in the printout (b) 1 = Include the joint frequency distributions in the printout

<u>Input Line 13</u> (8E10.3) Valid entries in the meteorological data base (same units as in the data base)

Col. 1-10	WDMAX	Maximum wind direction acceptable as a valid observation
Col. 11-20	WSMAX	Maximum wind speed acceptable as a valid observation; WSMAX defaults to [WSLIM(NWSIN)/WSCONV] if it is less than that ratio, where WSCONV in defined in Input Line 14; i.e., preference is given to the wind-speed group definitions, and all hourly observations with wind speeds in excess of WSLIM(NWSIN) (m/sec) will be excluded from the analysis.
Col. 21-30	DTMAX	Maximum temperature difference acceptable as a valid observation
Col. 31-40	SUNMAX	Maximum solar radiation acceptable as a valid observation
Col. 41-50	RAINMX	Maximum precipitation acceptable as a valid observation

<u>Input Line 14</u> (8E10.3) Met data conversion factors

Col. 1-10	WSCONV	Factor to convert input wind speed to m/sec

Col. 11-20	DTCONV	Factor to convert input temperature difference to 0C.
Col. 21-30	SUNCON	Factor to convert solar radiation to cal/min-cm^2
Col. 31-40	RAINCV	Factor to convert precipitation data to mm of water
Col. 41-50	WSCALM	Wind speed (m/sec) to be assigned to calms (i.e., to all hourly wind speed observations which are less than WSLIM(2), the minimum wind speed acceptable as a valid observation, as defined in Input Line 3A). As specified in Reg. Guide 1.111, for instruments conforming with the intent of Reg. Guide 1.23, WSCALM should be set equal to 0.5*WSLIM(2); for non-conforming instruments, WSCALM should be assigned the value of 0.1 (m/sec).
Col. 51-60	WSHITE	Height of wind speed measurement (m above release-point grade), as needed for extrapolation of the wind speeds in the data base to different heights (see parameter h(old) in Input Line 4). Set WSHITE=10 m if wind speed is measured at ground level; it defaults to 10 m if the user-specified value is <10 m.
Col. 61-70	DH	Temperature sensor separation (m)
Col. 71-80	WDVAR	Number assigned to variable wind directions (all variable wind directions will be assigned to calms)
<u>Input Line 15</u> (16I5)	Sea breeze data. Omit this input line if KVORS≤0.	
Col. 1-5	ISEAM1	First calendar month number in sea breeze season (e.g.: enter 5 for May)
Col. 6-10	ISEAM2	Last calendar month number in sea breeze season
Col. 14-15	ISEAH1	Sea breeze earliest daytime limit (hours) (≥0)
Col. 19-20	ISEAH2	Sea breeze latest daytime limit (hours) (≤23)
Col. 24-25	ISEASC(1)	First sea breeze downwind sector (1 for N, 2 for NNE, etc.; see input line 20 for sequence)
Col. 29-30	ISEASC(2)	Second sea breeze downwind sector (may be 0)
⋮		
Col. 79-80	ISEASC(12)	12th sea breeze downwind sector
<u>Input Line 16</u> (16I5)	Sea breeze data. Omit this input line if KVORS≤0	
Col. 5	ICSBM	Highest stability index (and default value) in the sea breeze joint frequency distribution that would be acceptable as a valid condition underneath the TIBL for sea breeze analysis (e.g.: if ICSBM = 4, identified sea breeze conditions with stabilities E, F and G in the sea breeze joint-frequency distribution will automatically default to stability D). Note that AEOLUS3 does not employ the stability index in the identification of sea breeze conditions. If ICSBM ≤ 0, or if ICSBM > 7, ICSBM defaults to 4.
Col. 10	ICSBD	Default stability index below the TIBL when the TIBL elevation is below the upper delta-T sensor on the meteorological tower. If ICSBD ≤ 0, or if ICSBD > 7, ICSBD defaults to 4.
<u>Input Line 17</u> (8E10.3)	Sea breeze data. Omit this input line if KVORS ≤ 0	
Col. 1-10	FWSMIN	Min. wind speed for sea breeze (m/sec)

Col. 11-20	FWSMAX	Maximum wind speed for sea breeze
Col. 21-30	SUNMIN	Min. solar radiation for sea breeze (may be 0.0) (cal/min-cm^2)
Col. 31-40	HINSB	Depth of inversion layer during sea breeze conditions (m above receptor grade) (Defaults to HINV in Input Line 6 if not provided, or if it is greater than HINV)
Col. 41-50	DTHITE	Height of upper level delta-T sensor (m above release-point grade)
Col. 51-60	TBLCOF(1)	User-specified coefficient for TIBL height calculation during sea breezes, based on the equation: $\text{TIBL HT} = \text{TBLCOF(1)}*(\text{Dist}*\text{Solar Rad})^{0.5} + \text{TBLCOF(2)}$ (Max. value = HINSB)
Col. 61-70	TBLCOF(2)	Second coefficient for the TIBL-height equation given above

<u>Input Line Set 18</u> Sea breeze data. Omit these input lines if KVORS $\leq$ 0

<u>Input Line 18A</u> (8E10.3)

Col. 1-10	DSHRP(1)	Distance (m) from release point to the shoreline - N sector
Col. 11-20	DSHRP(2)	Dist. from rel. pt to shoreline - NNE
Col. 21-30	DSHRP(3)	Dist. from rel. pt to shoreline - NE
Col. 31-40	DSHRP(4)	Dist. from rel. pt to shoreline - ENE
Col. 41-50	DSHRP(5)	Dist. from rel. pt to shoreline - E
Col. 51-60	DSHRP(6)	Dist. from rel. pt to shoreline - ESE
Col. 61-70	DSHRP(7)	Dist. from rel. pt to shoreline - SE
Col. 71-80	DSHRP(8)	Dist. from rel. pt to shoreline - SSE

<u>Input Line 18B</u> (8E10.3)

Col. 1-10	DSHRP(9)	Distance (m) from release point to shoreline - S sector
Col. 11-20	DSHRP(10)	Dist. from rel. pt to shoreline - SSW sector
Col. 21-30	DSHRP(11)	Dist. from rel. pt to shoreline - SW
Col. 31-40	DSHRP(12)	Dist. from rel. pt to shoreline - WSW
Col. 41-50	DSHRP(13)	Dist. from rel. pt to shoreline - W
Col. 51-60	DSHRP(14)	Dist. from rel. pt to shoreline - WNW
Col. 61-70	DSHRP(15)	Dist. from rel. pt to shoreline - NW
Col. 71-80	DSHRP(16)	Dist. from rel. pt to shoreline - NNW

Input Line Set 19 Sea breeze data. Omit these input lines if KVORS ≤ 0

Input Line 19A (8E10.3)

Col. 1-10	DSHMT(1)	Distance (m) from met-tower to shoreline - N sector
Col. 11-20	DSHMT(2)	Dist. from met-tower to shore. - NNE sector
Col. 21-30	DSHMT(3)	Dist. from met-tower to shore. - NE
Col. 31-40	DSHMT(4)	Dist. from met-tower to shore. - ENE
Col. 41-50	DSHMT(5)	Dist. from met-tower to shore. - E
Col. 51-60	DSHMT(6)	Dist. from met-tower to shore. - ESE
Col. 61-70	DSHMT(7)	Dist. from met-tower to shore. - SE
Col. 71-80	DSHMT(8)	Dist. from met-tower to shore. - SSE

Input Line 19B (8E10.3)

Col. 1-10	DSHMT(9)	Distance (m) from release point to shoreline - S sector
Col. 11-20	DSHMT(10)	Dist. from met-tower to shore. - SSW sector
Col. 21-30	DSHMT(11)	Dist. from met-tower to shore. - SW
Col. 31-40	DSHMT(12)	Dist. from met-tower to shore. - WSW
Col. 41-50	DSHMT(13)	Dist. from met-tower to shore. - W
Col. 51-60	DSHMT(14)	Dist. from met-tower to shore. - WNW
Col. 61-70	DSHMT(15)	Dist. from met-tower to shore. - NW
Col. 71-80	DSHMT(16)	Dist. from met-tower to shore. - NNW

Input Line 20 (I5,5X,7E10.3)

Valley data. Omit this input line if KVORS ≥ 0

Col. 5	IDTVAL	Lowest delta-T stability for in-valley flows (e.g: set IDTVAL = 4 if in-valley flows occur only with stabilities D, E, F and G)
Col. 11-20	WSVAL	Highest hourly wind speed beyond which in-valley flows cannot be sustained (m/sec). Defaults to the highest wind speed defined in Input Line Set 3 if not defined.

Input Line 21 (16I5) Valley data. Omit this input line if KVORS ≥ 0

Col. 5	IVALSC(1)	Valley orientation identification for the N sector. Set IVALSC(1) = 1 if the N sector is up-valley, IVALSC(1) = 2 if it is down-valley, or IVALSC(1) = 3 if it is in a cross-valley location. Entries not equal to 1 or 2 default to 3.
Col. 10	IVALSC(2)	Valley orientation ident. - NNE sector

Col. 15	IVALSC(3)	Valley orientation ident. - NE sector
Col. 20	IVALSC(4)	Valley orientation ident. - ENE sector
Col. 25	IVALSC(5)	Valley orientation ident. - E sector
Col. 30	IVALSC(6)	Valley orientation ident. - ESE sector
Col. 35	IVALSC(7)	Valley orientation ident. - SE sector
Col. 40	IVALSC(8)	Valley orientation ident. - SSE sector
Col. 45	IVALSC(9)	Valley orientation ident. - S sector
Col. 50	IVALSC(10)	Valley orientation ident. - SSW sector
Col. 55	IVALSC(11)	Valley orientation ident. - SW sector
Col. 60	IVALSC(12)	Valley orientation ident. - WSW sector
Col. 65	IVALSC(13)	Valley orientation ident. - W sector
Col. 70	IVALSC(14)	Valley orientation ident. - WNW sector
Col. 75	IVALSC(15)	Valley orientation ident. - NW sector
Col. 80	IVALSC(16)	Valley orientation ident. - NNW sector

Input Line 22 (I5,5X,7E10.3)

Time intervals for accidental releases. Omit this input line if KOPT=1 or 2 in Input Line 2. Typical time intervals of interest are 1, 2, 8, 16, 72 and 624 hrs.

Col. 5	NACCT	Number of time values at which accident X/Q's and D/Q's will be calculated (maximum 6)
Col. 11-20	ACCTIM(1)	First time value of interest (hours)
Col. 21-30	ACCTIM(2)	Second time value of interest (hours)
.		
.		
Col. ---	ACCTIM(NACCT)	Last time value of interest (hours)

Input Line 23 (20A4) Start of Receptor Data

Col. 1-80	TITL	Any alphanumeric characters to indicate the start of receptor data. The information on this input line does not appear in the printout. This input line is required whether or not there is receptor data in the input. (Note: you may omit the receptor data sets if you are only interested in the joint frequency distributions, for instance)

Input Line Set 24 Data for the first set of receptors of interest (if any). Note that each receptor set can have as many as 16 receptors, each at its own distance from the release point. However, for accidental releases, the overall site analyses will be carried out only if there is a receptor in each sector.

Input Line 24A (A1,A10)

Col. 1	ISTART	Enter a '*' in this column; it identifies the start of a new set of receptors.
Col. 2-11	RIDENT	Receptor identification, as would apply to all the receptors in this set; e.g.: 'SITE BNDRY', 'NEARST COW', '2.0 MILES'. Note that you can use only 10 characters, and that this information will appear as a heading in the summary tables; hence, RIDENT must be unique to each receptor set. See Cols. 61-80 of Input Line 24B for receptor-specific information.

Input Line 24B (A3,1X,I1,I5,F10.3,5F8.3,2A10)

Data for first receptor in this set

Col. 1-3	ISCT	Downwind sector in which the receptor is located, left-justified; e.g.: N, WSW, SE
Col. 5	KPRT	Printout control option for this receptor, as follows: (a) 0 = Do not provide intermediate results for this receptor in the printout (b) 1 = Provide intermediate results for this receptor in the printout (such as the X/Q values for each entry in the joint frequency distribution) Defaults to 0 if KPRINT = 0 in Input Line 2.
Col. 10	IVALOC	Receptor location in the valley, as follows: (a) 0 = Open terrain analyses and off-valley receptors (b) 1 = Receptors in up-valley locations (c) 2 = Receptors in down-valley locations Note that there is no relationship between this parameter and parameter IVALSC in Input Line 21. For instance, sector E may be identified as a cross-valley sector (at the release point), but the valley may meander into this sector at some distance from the release point, in which case a receptor in the E sector may indeed be within the valley.
Col. 11-20	DIST	Straight-line distance (m) from the release point to the receptor in the specified sector (Note: For the Murphy and Campe building make model at close-in receptors, enter the distance from the surface of the building causing the wake to the receptor).
Col. 21-28	HTERN	Terrain height at the receptor of interest (meters above the release point grade) Note: (a) In line with regulatory guidance, (Reg. Guide 1.111) select the maximum terrain height between the release point and the receptor (b) Negative terrain heights automatically exclude the receptor from the analysis; to exclude a receptor, simply do not include it in the set of receptors of interest
Col. 29-36	RCF	Recirculation correction factor for this receptor; this information will be used only if KCF=2 in Input Line 2. Defaults to unity if not provided.
Col. 37-44	VWIDTH	Valley width at the receptor of interest (m); defaults to 0 for off-valley receptors.
Col. 45-52	VSLOPE	Valley slope (0.1 to 90 degrees) at the receptor of interest; defaults to 0 for off-valley receptors. Note: A zero slope is equivalent to a flat terrain.
Col. 53-60	VDIST	Receptor distance (m) along the valley; leave blank only for non-valley cases. Set

DIST-5% ≤ VDIST ≤ DIST+5% in Input Line 24A for receptors exposed only to valley flows at all times; the X/Q's and D/Q's will be based entirely on the valley models. For other distances, the open-terrain models will be used for non-valley flows. Defaults to DIST if not provided.

Col. 61-80	DESCR	Receptor description (for general information, such as pathway). Note: to produce a tape7 file in the proper format for input to YODA, the data should consist of 3 variables, PTH(1) through PTH(3), entered as 2X,2A6,F6.4 within columns 61-80 where:

PTH(1) = pathway code 1, a description used by ATMODOS to determine the active environmental pathways

PTH(2) = pathway code 2 (same as above)

PTH(3) = occupancy correction factor for use in ATMODOS

Input Lines 24C-24X These input lines are similar to Input Line 24B for the other receptors of interest located in different sectors. There is no need to include sectors of no interest. If a sector is entered twice, the latest entry will be used. You will run into problems if you misspell the sector name in Cols. 1-3.

Input Line Sets 25-Last Data for the remaining sets of receptors, as described for the first receptor set in Input Line Set 24. There is no limit to the number of receptors in the accident mode. For continuous and intermittent releases, the software can currently handle up to a maximum of 99 receptor sets (i.e., a maximum of 99x16 individual receptors, one at each of 99 distances in each sector).

ATTACHMENT B: AEOLUS3 INPUTS FOR MS AND GROUND RELEASES

Line 1: Title

TITLE PNPS ACCIDENT X/Q - 5-YR 220-FT MET DATA - MS: ELEVATED X/Q vs distance msdiscr
PNPS ACCIDENT X/Q - 5-YR 220-FT MET DATA - MS: ELEVATED X/Q vs distance msdistsc
PNPS ACCIDENT X/Q - 5-YR 220-FT MET DATA - MS: ELEVATED TO EAB mstoeab
PNPS ACCIDENT X/Q - 5-YR 220-FT MET DATA - MS: ELEVATED TO EAB mstoeab2
PNPS ACCIDENT X/Q - 5-YR 220-FT MET DATA - MS: ELEVATED TO LPZ mstolpz
PNPS ACCIDENT X/Q - 5-YR 220-FT MET DATA - MS: ELEVATED TO LPZ mstolpz2
PNPS ACCIDENT X/Q - 5-YR 220-FT TOWER 33-FT MET DATA - RB X/Q vs dis - rbdis
PNPS ACCIDENT X/Q - 5-YR 220-FT TOWER 33-FT MET DATA - RB TO EAB – rbtoeab
PNPS ACCIDENT X/Q - 5-YR 220-FT TOWER 33-FT MET DATA - RB TO EAB – rbtoeab2
PNPS ACCIDENT X/Q - 5-YR 220-FT TOWER 33-FT MET DATA - RB TO LPZ rbtolpz
PNPS ACCIDENT X/Q - 5-YR 220-FT TOWER 33-FT MET - TB GR-LEVEL X/Q vs dis tbdis
PNPS ACCIDENT X/Q - 5-YR 220-FT TOWER 33-FT MET - TB GROUND-LEVEL TO EAB tbtoeab
PNPS ACCIDENT X/Q - 5-YR 220' TOWER 33' MET DATA - TB GROUND-LEVEL TO LPZ tbtolpz
PNPS ACCIDENT X/Q - 5-YR 220' TOWER 33' MET DATA - YD X/Q vs distance yrddis

Line 2: Program Control Options

KOPT	3	Set to 3 for accident scenario
KPRINT	0	Set printout control option to short printout
KMN	1	Set plume meander control option to include plume meander in the plume centerline CHI/Q's
KCF	0	Set control option for recirculation correction to no correction
KWEXP	1	Set wind-speed extrapolation control option to use XOQDOQ extrapolation coefficients
KGX	1	Set gamma CHI/Q control option to include this calculation
KSIG	0	Set model-selection control option for dispersion coefficients to the ENTECH model
KVORS	0	Set the sea breeze/valley model option to open terrain analysis
KDEPL	0	Set depletion model control option to Reg. Guide 1.111 curves
KRAIN	0	Set wet deposition control option to not evaluate wet deposition effects
NWSIN	12	Set number of wind speed groups to twelve
NEG	0/1	Set number of gamma energy groups in the user-specified spectrum to zero (equal to 1 in 3 special cases)
INTERM	0	Set the duration of batch releases to zero
IPCT	0	Set the hourly value exceedance probability for batch releases to zero
NMONTH	60	Set number of monthly records in the met data base to 60
KTP7	{ }	Sets the control option for transferring information to tape7 to 1 for continuous runs (sector average X/Q's transferred) by default

Line 3A: Wind Speed Group Definition

WSLIM(2)	0.45	Set the upper wind speed in the first wind speed group to 0.45 m/sec (assumes anemometer/wind vane starting speed meets RG 1.23 criterion of 1 mph)
WSLIM(3)	1.0	Set the upper wind speed in the second wind speed group to 1.0 m/sec
WSLIM(4)	2.0	Set the upper wind speed in the third wind speed group to 2.0 m/sec
WSLIM(5)	3.0	Set the upper wind speed in the fourth wind speed group to 3.0 m/sec
WSLIM(6)	4.0	Set the upper wind speed in the fifth wind speed group to 4.0 m/sec
WSLIM(7)	5.0	Set the upper wind speed in the sixth wind speed group to 5.0 m/sec
WSLIM(8)	6.0	Set the upper wind speed in the seventh wind speed group to 6.0 m/sec
WSLIM(9)	8.0	Set the upper wind speed in the eighth wind speed group to 8.0 m/sec

Line 3B: Wind Speed Group Definition (continued)

WSLIM(10)	10.0	Set the upper wind speed in the ninth wind speed group to 10.0 m/sec
WSLIM(11)	13.0	Set the upper wind speed in the tenth wind speed group to 13.0 m/sec
WSLIM(12)	18.0	Set the upper wind speed in the eleventh wind speed group to 18.0 m/sec
WSLIM(13)	22.4	Set the upper wind speed in the eleventh wind speed group to 22.4 m/sec

Line 4: Wind-Speed Extrapolation Data

Omit this line since using built-in extrapolation coefficients (KWEXP=1)

Line 5: Release-Point Data (Refer to Appendix F of Reference 3 for basis of values.)

HREL	99.7/102.1/0.0	Set the height of release to 99.7 meters for MS to CR, 102.1 meters (335') above plant grade for MS to TSC, EAB and LPZ; set to 0.0 for ground release
HBLD	0.0/43.6/25.9/0.0	Set the height of the building adjacent to the release point to 0.0 for MS, 43.6 for RB, 25.9 for TB, 0.0 for Yard
BAREA	0.0/1886.0/2116.0/0.0	Set cross-sectional area of building adjacent to 0.0 for MS, 1886.0 for RB, 2116.0 for TB, 0.0 for Yard
DIAMTR	0.0	Set MS effective internal diameter to 0.0 m, set to 0.0 for all other releases (no plume rise)
VFLOW	0.0	Set MS flow to 0.0 scfm (assume no credit of SGTS flow, and no plume rise); set to 0.0 for ground releases
QH	0.0	Set effluent heat content to 0.0 cal/sec (bypass plume rise effects)
CONDIA	{ }	Leave blank equivalent diameter of building causing wake effects for use in conjunction with the Murphy and Campe building wake model to
RVUSER	{ }	Leave blank Set the value of Rv (vent exit velocity to wind speed ratio) for the definition of plume entrainment to 0.0

Line 6: General Site Data

HINV	630.	Set annual average height of the inversion layer at the selected site to 630 m above receptor grade
HFMX	630.	Set maximum allowable plume centerline height to 630 m above receptor grade (not applicable to ground level releases)
THLFNG	2.26	Set noble gas half-life for decay-in-transit analysis to 2.26 days
THLFIO	8.0	Set iodine half-life for decay-in-transit analysis to 8.0 days
SCAVCF(1)	{ }	Leave first user-specified coefficient for scavenging rate due to rainfall blank (do not evaluate wet deposition effects)
SCAVCF(2)	{ }	Leave second user-specified coefficient for scavenging rate due to rainfall blank (do not evaluate wet deposition effects)

Line 7: Gamma Energy Spectra for the Gamma CHI/Qs – omit (Used value of 0.2MeV in 3 special cases)

Line 8: Gamma Energy Spectra for the Gamma CHI/Qs – omit (Used value of 1.0 in 3 special cases)

Line 9: Release Isotopics for the Gamma CHI/Qs – Line omitted for the 3 cases with 0.2 MeV

CONC(1)	0.0	Br-83 relative concentration set to zero
CONC(2)	0.0	Br-84 relative concentration set to zero
CONC(3)	0.0	Br-85 relative concentration set to zero
CONC(4)	0.0	Br-88 relative concentration set to zero
CONC(5)	0.0	Kr-83m relative concentration set to zero
CONC(6)	0.0	Kr-85m relative concentration set to zero
CONC(7)	0.0	Kr-85 relative concentration set to zero
CONC(8)	0.0	Kr-87 relative concentration set to zero
CONC(9)	0.0	Kr-88 relative concentration set to zero
CONC(10)	0.0	Kr-89 relative concentration set to zero
CONC(11)	0.0	Kr-90 relative concentration set to zero
CONC(12)	0.0	I-129 relative concentration set to zero
CONC(13)	0.0	I-130 relative concentration set to zero
CONC(14)	0.0	I-131 relative concentration set to zero
CONC(15)	0.0	I-132 relative concentration set to zero
CONC(16)	0.0	I-133 relative concentration set to zero

CONC(17)	0.0	I-134 relative concentration set to zero
CONC(18)	0.0	I-135 relative concentration set to zero
CONC(19)	0.0	I-136 relative concentration set to zero
CONC(20)	0.0	Xe-131m relative concentration set to zero
CONC(21)	0.0	Xe-133m relative concentration set to zero
CONC(22)	1.0	Xe-133 relative concentration set to one (conservative)
CONC(23)	0.0	Xe-135m relative concentration set to zero
CONC(24)	0.0	Xe-135 relative concentration set to zero
CONC(25)	0.0	Xe-137 relative concentration set to zero
CONC(26)	0.0	Xe-138 relative concentration set to zero
CONC(27)	0.0	Ar-41 relative concentration set to zero
CONC(28)	0.0	N-13 relative concentration set to zero

Line 10: Deposition Velocity/Atmospheric Stability Correlations - omit

Line 11: Meteorological Data Input Format

IMT (4(i2,1x),t50,f4.0,1x,f4.1,16x,f4.1,1x,f2.1,1x,f2.1) For MS

Meteorological data input format for year, month, day, hour, upper level wind speed, upper level wind direction, temperature difference, precipitation, and solar radiation

(4(i2,1x),t60,f4.0,1x,f4.1,6x,f4.1,1x,f2.1,1x,f2.1) For Yard, RB, TB

Meteorological data input format for year, month, day, hour, lower level wind speed, lower level wind direction, temperature difference, precipitation, and solar radiation

Line 12: Meteorological Data Input Sequence

ID(1)	1	Sequence number of year in IMT
ID(2)	2	Sequence number of month in IMT
ID(3)	3	Sequence number of day in IMT
ID(4)	4	Sequence number of hour in IMT
ID(5)	5	Sequence number of wind direction in IMT
ID(6)	6	Sequence number of wind speed in IMT
ID(7)	7	Sequence number of temperature difference in IMT
ID(8)	0	Sequence number of solar radiation in IMT

ID(9)	0	Sequence number of precipitation in IMT
KPRMET	3	Set printout control option for the hourly met data to print the first 3 entries in each month
KPRJFD	{ }	Set printout control option for the joint frequency distributions to not include the joint frequency distributions in the printout

Line 13: Valid Entries in the Meteorological Data Base

WDMAX	360.	Set the maximum wind direction acceptable as a valid observation to 360°
WSMAX	99.	Set the maximum wind speed acceptable as a valid observation to 99 m/sec
DTMAX	25.	Set the maximum temperature difference acceptable as a valid observation to 25°C
SUNMX	0.0	Set the maximum solar radiation acceptable as a valid observation to 2.0 ly/min (no data)
RAINMX	0.0	Set the maximum precipitation acceptable as a valid observation to 0.0 in/hr (no precip data)

Line 14: Meteorological Data Conversion Factors

WSCONV	0.447	Set the factor to convert the input wind speed data to m/sec to 0.447
DTCONV	0.556	Set the factor to convert the input temperature difference data to °C to 0.556
SUNCON	1.0	Set the factor to convert the input solar radiation data from langley/min to cal/min-cm^2 to 1.0
RAINCV	25.4	Set factor to convert precipitation data from in/hr to mm/hr to 25.4
WSCALM	0.225	Set wind speed to be assigned to calms to 0.225 m/sec (half of anemometer/wind vane starting speed)
WSHITE	67.1/10.1	Set height of wind speed measurement to 67.1 m above release-point grade for MS and 10.1 m for all others
DH	57.0	Set the delta-temperature sensor separation to 57.0m (220-33) X 0.3048 = 57.0m
WDVAR	{ }	Set number assigned to variable wind directions to blank

Lines 15-19: Sea Breeze Data

Omit these lines since the sea breeze model option is not being used (KVORS=0)

Lines 20-21: Valley Data

Omit these lines since the valley model option is not being used (KVORS=0)

Line 22: Time Intervals for Accidental Releases

NACCT	5/1	Use five time values for rbdis, tbdis, msdis, yrddis, lpz cases; use one for eab cases cases
ACCTIM(1)	2.0	Set to two hours

ACCTIM(2)	6.0	Set to six hours for rbdis, tbdis, msdis, yrddis, and lpz cases
ACCTIM(3)	16.0	Set to sixteen hours for rbdis, tbdis, msdis, yrddis, lpz cases
ACCTIM(4)	72.0	Set to 72 hours for rbdis, tbdis, msdis, yrddis, lpz cases
ACCTIM(5)	624.0	Set to 624 hours for rbdis, tbdis, msdis, yrddis, lpz cases

Line 23: Start of Receptor Data

TITL	RECEPTORS

Line Sets 24A-29A: Data for the Receptors of Interest

ISTART	*
RIDENT	SITE LPZ, SITE EAB, 200m, 400m, 600m, 800m, 1000m, EAB-50m, EAB-100m, Dis-10m, Dis-50m, Dis-100m, Dis-200m, Dis-300m, Dis-400m, Dis-500m (See files for specifics)

Line Sets 24B-29X: Data for the Receptors of Interest

ISCT	N, NNE, NE, ... NNW	
KPRT	0	Set printout control option to not provide intermediate results in the printout (except for certain sectors)
IVALOC	0	Set the receptor location in the valley to indicate open terrain analyses
DIST	See Section 3.0 for all cases	
HTERN	See Section 3.0 for Main Stack case; set to zero for Reactor and Turbine Building cases	
RCF	0.0	Set the recirculation correction factors to zero
VWIDTH	0.0	Set the valley width at the receptor of interest to zero
VSLOPE	0.0	Set the valley slope at the receptor of interest to zero
VDIST	0.0	Set the receptor distance along the valley to zero
DESCR	See files	Set the receptor description to: two-letter code for release point (MS, RB, TB, or YD), distance, sector

ATTACHMENT C: COMPUTER INPUT AND OUTPUT FILE NAMES

The following computer runs were carried out for this calculation:

aeolus3

1.	msdiscr	Main Stack to various downwind distances (CR case)
2.	msdistsc	Main Stack to various downwind distances (TSC case)
3.	mstoeab	Main Stack to Exclusion Area Boundary
4.	mstolpz	Main Stack to Low Population Zone
5.	mstoeab2	Main Stack to Exclusion Area Boundary (0.2MeV run)
6.	mstolpz2	Main Stack to Low Population Zone (0.2MeV run)
7.	rbdis	Reactor Building to various downwind distances
8.	rbtoeab	Reactor Building to Exclusion Area Boundary
9.	rbtoeab2	Reactor Building to Exclusion Area Boundary (0.2MeV run)
10.	rbtolpz	Reactor Building to Low Population Zone
11.	tbdis	Turbine Building to various downwind distances
12.	tbtoeab	Turbine Building to Exclusion Area Boundary
13.	tbtolpz	Turbine Building to Low Population Zone
14.	yrddis	Yard Area to various downwind distances

ARCON96

1.	mscr	Main Stack to Control Room
2.	mstsc	Main Stack to Technical Support Center
3.	rbcr1	Reactor Building Vent to Control Room
4.	rbtsc1	Reactor Building Vent to Technical Support Center
5.	rbtlcr1	Reactor Building Truck Lock to Control Room
6.	rbtltsc1	Reactor Building Truck Lock to Technical Support Center
7.	rbncr	Reactor Building North Wall to Control Room
8.	rbntsc	Reactor Building North Wall to Technical Support Center
9.	rfpcr1	Turbine Building Reactor Fuel Pump to Control Room
10.	rfptsc1	Turbine Building Reactor Fuel Pump to Technical Support Center
11.	tbcr1	Turbine Building to Control Room
12.	tbtsc1	Turbine Building to Technical Support Center

Listing of Files Included on the Compact Disc and Transferred to the FANP COLD Server for Archival Storage

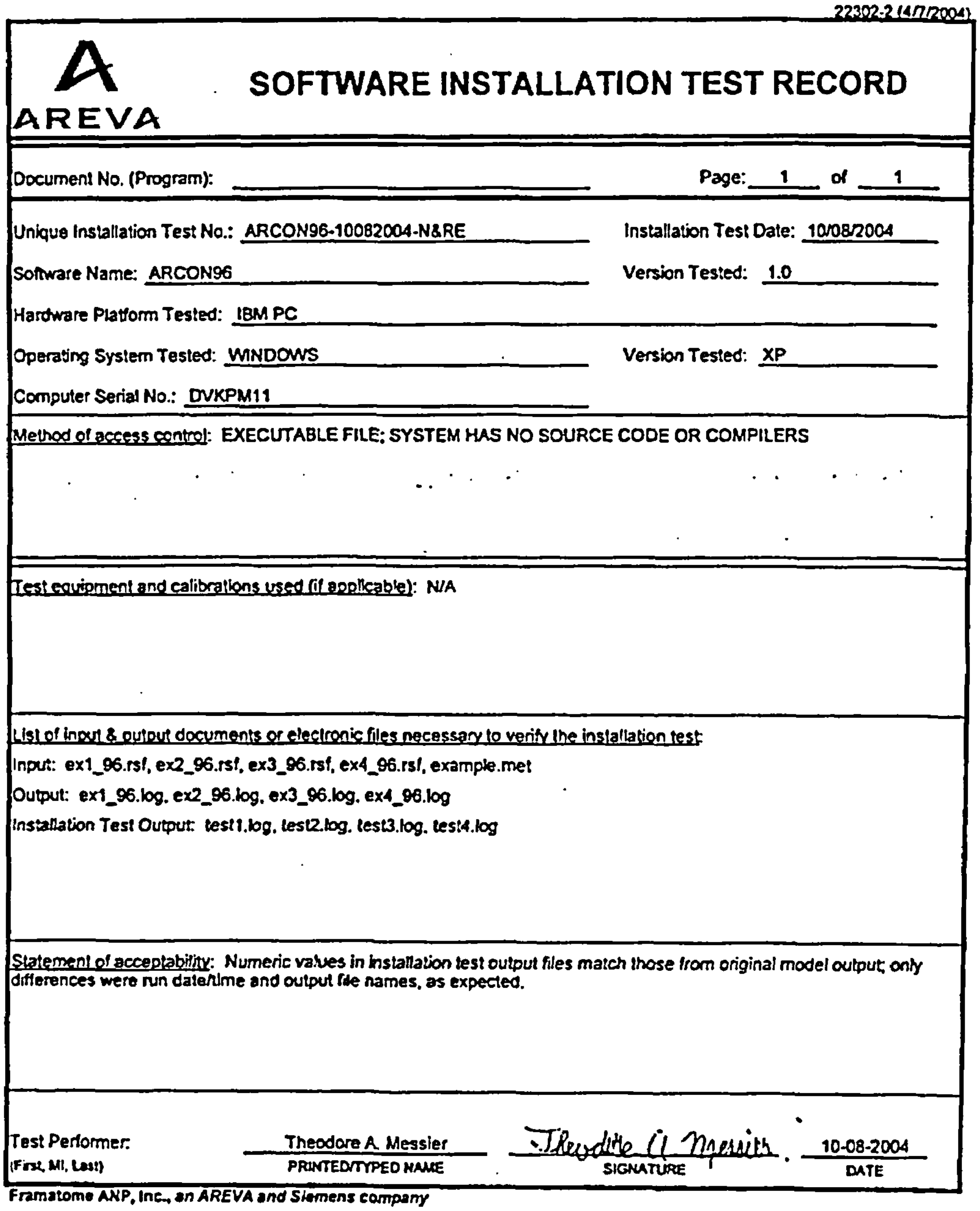
File Size in Bytes	Date	Time	File Name	File Description
Meteorological Data Files				
693984	10/19/2004	09:27	bemet00.new	input 2000 meteorological data for aeolus3
693984	10/19/2004	09:26	bemet96.new	input 1996 meteorological data for aeolus3
692088	10/19/2004	09:27	bemet97.new	input 1997 meteorological data for aeolus3
692088	10/19/2004	09:27	bemet98.new	input 1998 meteorological data for aeolus3
692088	10/19/2004	09:27	bemet99.new	input 1999 meteorological data for aeolus3
3464232	10/19/2004	09:40	be9600.met	PNPS 1996 - 2000 met data in one file for aeolus3
316224	10/19/2004	09:35	pnps00.met	input 2000 meteorological data for ARCON96
316224	10/19/2004	09:35	pnps96.met	input 1996 meteorological data for ARCON96
315360	10/19/2004	09:35	pnps97.met	input 1997 meteorological data for ARCON96
315360	10/19/2004	09:35	pnps98.met	input 1998 meteorological data for ARCON96
315360	10/19/2004	09:35	pnps99.met	input 1999 meteorological data for ARCON96
ARCON96 Input/Output Files				
5,030	10/26/2004	07:59	mscr.log	MS to CR output
566	10/26/2004	07:59	MSCR.RSF	MS to CR input
5,030	10/26/2004	08:00	mstsc.log	MS to TSC output
566	10/26/2004	07:59	MSTSC.RSF	MS to TSC input
5,034	10/26/2004	08:04	rbcr1.log	RB vent to CR output
566	10/26/2004	08:04	RBCR1.RSF	RB vent to CR input
5,034	10/26/2004	08:06	rbtlcr1.log	RB truck lock to CR output
566	10/26/2004	08:06	RBTLCR1.RSF	RB truck lock to CR input
5,034	10/26/2004	08:07	rbtltsc1.log	RB truck lock to TSC output
566	10/26/2004	08:07	RBTLTSC1.RSF	RB truck lock to TSC input
5,034	10/26/2004	08:08	rbtsc1.log	RB vent to TSC output
566	10/26/2004	08:08	RBTSC1.RSF	RB vent to TSC input
566	10/26/2004	08:08	rbncr.rsf	RB North Wall to CR input
5,034	10/26/2004	08:08	rbncr.log	RB North Wall to CR output
566	10/26/2004	08:08	rbntsc.rsf	RB North Wall to TSC input
5,034	10/26/2004	08:08	rbntsc.log	RB North Wall to TSC output
5,034	10/26/2004	08:08	rfpcr1.log	TB Reactor Feed Pump Area to CR output
566	10/26/2004	08:08	RFPCR1.RSF	TB Reactor Feed Pump Area to CR input
5,034	10/26/2004	08:09	rfptsc1.log	TB Reactor Feed Pump Area to TSC output
566	10/26/2004	08:09	RFPTSC1.RSF	TB Reactor Feed Pump Area to TSC input
5,034	10/26/2004	08:10	tbcr1.log	TB to CR output
566	10/26/2004	08:10	TBCR1.RSF	TB to CR input
5,034	10/26/2004	08:11	tbtsc1.log	TB to TSC output
566	10/26/2004	08:11	TBTSC1.RSF	TB to TSC input
aeolus3 Input/Output Files				
10946	11/02/2004	09:13	msdiscr.a3	MS to various distances input file (CR case)
324299	11/02/2004	09:15	msdiscr.out	MS to various distances output file (CR case)
10947	11/02/2004	09:12	msdistsc.a3	MS to various distances input file (TSC case)
324308	11/02/2004	09:15	msdistsc.out	MS to various distances output file (TSC case)
2194	11/02/2004	10:10	mstoeab.a3	MS to EAB input file
81775	11/02/2004	10:11	mstoeab.out	MS to EAB output file
1945	11/02/2004	09:13	mstoeab2.a3	MS to EAB input file (0.2MeV run)
81564	11/02/2004	09:15	mstoeab2.out	MS to EAB output file (0.2MeV run)
2207	11/02/2004	09:14	mstolpz.a3	MS to LPZ input file
87583	11/02/2004	09:17	mstolpz.out	MS to LPZ output file
1953	11/02/2004	09:14	mstolpz2.a3	MS to LPZ input file (0.2MeV run)
87372	11/02/2004	09:17	mstolpz2.out	MS to LPZ output file (0.2MeV run)
9346	11/02/2004	11:01	rbdis.a3	RB to various distances input file
290033	11/02/2004	11:01	rbdis.out	RB to various distances output file
2122	10/26/2004	10:45	rbtoeab.a3	RB to EAB input file
81775	10/26/2004	10:57	rbtoeab.out	RB to EAB output file
1861	11/02/2004	10:20	rbtoeab2.a3	RB to EAB input file (0.2MeV run)
81564	11/02/2004	10:20	rbtoeab2.out	RB to EAB output file (0.2MeV run)
2160	11/02/2004	09:39	rbtolpz.a3	RB to LPZ input file
87583	11/02/2004	09:40	rbtolpz.out	RB to LPZ output file
8483	10/27/2004	14:52	tbdis.a3	TB to various distances input file
256430	10/27/2004	14:52	tbdis.out	TB to various distances output file
2176	10/26/2004	10:46	tbtoeab.a3	TB to EAB input file
81775	10/26/2004	10:58	tbtoeab.out	TB to EAB output file

Listing of Files Included on the Compact Disc and Transferred to the FANP COLD Server for Archival Storage (continued)

File Size in Bytes	Date	Time	File Name	File Description
aeolus3 Input/Output Files				
2215	11/02/2004	09:39	tbtolpz.a3	TB to LPZ input file
87583	11/02/2004	09:40	tbtolpz.out	TB to LPZ output file
9340	10/27/2004	14:09	yrddis.a3	Yard to various distances input file
290042	10/27/2004	14:10	yrddis.out	Yard to various distances output file

Note: The time stamp for the files on the CD that were created before 10/31/2004 on the system will be one hour less than shown above; this is due to the Windows XP operating system changing the time stamps of all files whenever Daylight Savings Time ends or begins. The exception to this is the ARCON96 input/output files – since they were created on the PC on 10/26/2004, the time stamp was changed by Windows XP and this matches the time stamp for the files transferred to the FANP COLD server for archival storage.

ATTACHMENT D: ARCON96 SOFTWARE INSTALLATION TEST RECORD



22302-2 (4/7/2004)

AREVA

SOFTWARE INSTALLATION TEST RECORD

Document No. (Program): ____ Page: 1 of 1

Unique Installation Test No.: ARCON96-10082004-N&RE Installation Test Date: 10/08/2004

Software Name: ARCON96 Version Tested: 1.0

Hardware Platform Tested: IBM PC

Operating System Tested: WINDOWS Version Tested: XP

Computer Serial No.: DVKPM11

Method of access control: EXECUTABLE FILE; SYSTEM HAS NO SOURCE CODE OR COMPILERS

Test equipment and calibrations used (if applicable): N/A

List of input & output documents or electronic files necessary to verify the installation test:

Input: ex1_96.rsf, ex2_96.rsf, ex3_96.rsf, ex4_96.rsf, example.met

Output: ex1_96.log, ex2_96.log, ex3_96.log, ex4_96.log

Installation Test Output: test1.log, test2.log, test3.log, test4.log

Statement of acceptability: *Numeric values in installation test output files match those from original model output; only differences were run date/time and output file names, as expected.*

Test Performer: (First, MI, Last) Theodore A. Messier (PRINTED/TYPED NAME) Theodore A Messier (SIGNATURE) 10-08-2004 (DATE)

Framatome ANP, Inc., an AREVA and Siemens company

Emailed to Rick Rouse on 10-08-04.

ATTACHMENT E: ARCON96 OUTPUT

Main Stack to Control Room

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  10/26/2004  at  08:59:35

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Elevated release
    Release height (m)                   =    102.1
    Building Area (m^2)                  =       .0
```

```
 Effluent vertical velocity (m/s)      =      4.06
 Vent or stack flow  (m^3/s)           =      1.70
 Vent or stack radius (m)              =       .37

 Direction .. intake to source (deg)   =      303
 Wind direction sector width (deg)     =       90
 Wind direction window (deg)           =   258 - 348
 Distance to intake (m)                =    244.0
 Intake height  (m)                    =     15.2
 Terrain elevation difference (m)      =     12.8

 Output file names
   pnps\mscr.log
   pnps\mscr.cfd

 Minimum Wind Speed (m/s)              =       .5
 Surface roughness length (m)          =       .20
 Sector averaging constant             =      4.3

 Initial value of sigma y              =       .00
 Initial value of sigma z              =       .00

 Expanded output for code testing not selected

 Total number of hours of data processed =  43848
 Hours of missing data                   =   1858
 Hours direction in window               =  13383
 Hours elevated plume w/ dir. in window  =   8847
 Hours of calm winds                     =     12
 Hours direction not in window or calm   =  28595

 DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
AVER. PER.          1          2          4          8         12         24         96        168        360        720
UPPER LIM.   1.00E-05   1.00E-05   1.00E-05   1.00E-05   1.00E-05   1.00E-05   1.00E-05   1.00E-05   1.00E-05   1.00E-05
  LOW LIM.   1.00E-09   1.00E-09   1.00E-09   1.00E-09   1.00E-09   1.00E-09   1.00E-09   1.00E-09   1.00E-09   1.00E-09
ABOVE RANGE        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
  IN RANGE      2653.      3398.      4700.      7122.      9622.     15432.     29969.     34166.     36877.     38722.
BELOW RANGE        0.         0.         0.        45.       449.      1238.      2194.      1728.       488.         0.
      ZERO     39337.     38377.     36657.     33377.     31040.     24137.      7721.      2824.       271.         0.
TOTAL X/Qs     41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
% NON ZERO      6.32       8.13      11.36      17.68      24.50      40.85      80.64      92.71      99.28     100.00

 95th PERCENTILE X/Q VALUES
             3.50E-07   4.01E-07   3.70E-07   3.27E-07   2.50E-07   1.50E-07   8.17E-08   6.99E-08   5.92E-08   5.47E-08

 95% X/Q for standard averaging intervals

 0 to 2 hours        4.01E-07
 2 to 8 hours        3.02E-07
 8 to 24 hours       6.18E-08
 1 to 4 days         5.89E-08
 4 to 30 days        5.05E-08
```

```
                              HOURLY VALUE RANGE
                            MAX X/Q                 MIN X/Q
        CENTERLINE         9.73E-06                2.14E-42
        SECTOR-AVERAGE     5.67E-06                8.38E-43

NORMAL PROGRAM COMPLETION
```

Main Stack to Technical Support Center

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyll@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  10/26/2004  at  08:59:57

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Elevated release
    Release height (m)                   =    102.1
    Building Area (m^2)                  =       .0
    Effluent vertical velocity (m/s)     =     4.06
    Vent or stack flow  (m^3/s)          =     1.70
    Vent or stack radius (m)             =      .37
```

```
 Direction .. intake to source (deg)   =     304
 Wind direction sector width (deg)     =      90
 Wind direction window (deg)           =   259 - 349
 Distance to intake (m)                =    280.0
 Intake height  (m)                    =      3.0
 Terrain elevation difference (m)      =     12.8

 Output file names
   pnps\mstsc.log
   pnps\mstsc.cfd

 Minimum Wind Speed (m/s)              =       .5
 Surface roughness length (m)          =      .20
 Sector averaging constant             =      4.3

 Initial value of sigma y              =      .00
 Initial value of sigma z              =      .00

 Expanded output for code testing not selected

 Total number of hours of data processed =  43848
 Hours of missing data                   =   1858
 Hours direction in window               =  13348
 Hours elevated plume w/ dir. in window  =   8813
 Hours of calm winds                     =     12
 Hours direction not in window or calm   =  28630

 DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.           1          2          4          8         12         24         96        168        360        720
 UPPER LIM.    1.00E-04   1.00E-04   1.00E-04   1.00E-04   1.00E-04   1.00E-04   1.00E-04   1.00E-04   1.00E-04   1.00E-04
   LOW LIM.    1.00E-08   1.00E-08   1.00E-08   1.00E-08   1.00E-08   1.00E-08   1.00E-08   1.00E-08   1.00E-08   1.00E-08
ABOVE RANGE          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
   IN RANGE       2588.      3060.      4088.      6202.      8775.     14782.     27498.     29989.     32476.     35775.
BELOW RANGE         81.       352.       624.       979.      1284.      1794.      4416.      5832.      4889.      2947.
       ZERO      39321.     38363.     36645.     33363.     31052.     24231.      7970.      2897.       271.         0.
 TOTAL X/Qs      41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
 % NON ZERO        6.36       8.17      11.39      17.71      24.47      40.62      80.02      92.52      99.28     100.00

 95th PERCENTILE X/Q VALUES
               4.56E-07   5.14E-07   4.73E-07   4.18E-07   3.19E-07   1.93E-07   1.04E-07   9.02E-08   7.63E-08   6.99E-08

 95% X/Q for standard averaging intervals

 0 to 2 hours        5.14E-07
 2 to 8 hours        3.85E-07
 8 to 24 hours       8.04E-08
 1 to 4 days         7.48E-08
 4 to 30 days        6.46E-08

                           HOURLY VALUE RANGE
                         MAX X/Q                 MIN X/Q
```

```
          CENTERLINE          1.26E-05               5.48E-43
          SECTOR-AVERAGE      7.36E-06               2.12E-43

NORMAL PROGRAM COMPLETION
```

Reactor Building Vent to Control Room

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee       Phone: (301) 415 1080
                                e-mail: jyl1@nrc.gov
                J. J. Hayes     Phone: (301) 415 3167
                                e-mail: jjh@nrc.gov
                L. A  Brown     Phone: (301) 415 1232
                                e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell  Phone: (509) 372 6316
                                e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

The program was prepared for an agency of the United States Government. Neither
the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:04:56

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     48.5
    Building Area (m^2)                  =   1886.0
    Effluent vertical velocity (m/s)     =      .00
    Vent or stack flow  (m^3/s)          =      .00
    Vent or stack radius (m)             =      .00
```

```
Direction .. intake to source (deg)  =      285
Wind direction sector width (deg)    =       90
Wind direction window (deg)          =   240 - 330
Distance to intake (m)               =     48.8
Intake height  (m)                   =     15.2
Terrain elevation difference (m)     =       .0

Output file names
  pnps\rbcr1.log
  pnps\rbcr1.cfd

Minimum Wind Speed (m/s)             =       .5
Surface roughness length (m)         =       .20
Sector averaging constant            =      4.3

Initial value of sigma y             =       .00
Initial value of sigma z             =       .00

Expanded output for code testing not selected

Total number of hours of data processed =  43848
Hours of missing data                   =   1858
Hours direction in window               =  14077
Hours elevated plume w/ dir. in window  =      0
Hours of calm winds                     =    163
Hours direction not in window or calm   =  27750

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
AVER. PER.          1          2          4          8         12         24         96        168        360        720
UPPER LIM.   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02
  LOW LIM.   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06
ABOVE RANGE        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
  IN RANGE     14240.     15895.     18359.     21911.     25373.     31455.     39226.     38675.     37636.     38722.
BELOW RANGE        0.         0.         0.         0.         0.         0.         2.         0.         0.         0.
      ZERO     27750.     25880.     22998.     18633.     15738.      9352.       656.        43.         0.         0.
TOTAL X/Qs     41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
% NON ZERO      33.91      38.05      44.39      54.04      61.72      77.08      98.36      99.89     100.00     100.00

 95th PERCENTILE X/Q VALUES
             1.76E-03   1.68E-03   1.55E-03   1.38E-03   1.09E-03   7.44E-04   4.62E-04   4.01E-04   3.47E-04   3.35E-04

 95% X/Q for standard averaging intervals

 0 to 2 hours        1.76E-03
 2 to 8 hours        1.25E-03
 8 to 24 hours       4.26E-04
 1 to 4 days         3.67E-04
 4 to 30 days        3.15E-04

                          HOURLY VALUE RANGE
                        MAX X/Q               MIN X/Q
```

```
          CENTERLINE          2.30E-03                 5.13E-05
          SECTOR-AVERAGE      1.34E-03                 2.99E-05

NORMAL PROGRAM COMPLETION
```

Reactor Building Vent to Technical Support Center

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee       Phone: (301) 415 1080
                                e-mail: jyl1@nrc.gov
                J. J. Hayes     Phone: (301) 415 3167
                                e-mail: jjh@nrc.gov
                L. A  Brown     Phone: (301) 415 1232
                                e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell  Phone: (509) 372 6316
                                e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

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the United States Government nor any agency thereof, nor any of their
employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:08:23

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     48.5
    Building Area (m^2)                  =   1886.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00
```

```
Direction .. intake to source (deg)   =      290
Wind direction sector width (deg)     =       90
Wind direction window (deg)           =   245 - 335
Distance to intake (m)                =     85.3
Intake height  (m)                    =      3.0
Terrain elevation difference (m)      =       .0

Output file names
  pnps\rbtscl.log
  pnps\rbtscl.cfd

Minimum Wind Speed (m/s)              =       .5
Surface roughness length (m)          =      .20
Sector averaging constant             =      4.3

Initial value of sigma y              =      .00
Initial value of sigma z              =      .00

Expanded output for code testing not selected

Total number of hours of data processed =  43848
Hours of missing data                   =   1858
Hours direction in window               =  13953
Hours elevated plume w/ dir. in window  =      0
Hours of calm winds                     =    163
Hours direction not in window or calm   =  27874

 DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.         1          2          4          8         12         24         96        168        360        720
 UPPER LIM.  1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03
   LOW LIM.  1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07
ABOVE RANGE        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
   IN RANGE    14116.     15727.     18129.     21601.     24982.     31057.     39176.     38675.     37636.     38722.
BELOW RANGE        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
       ZERO    27874.     26048.     23228.     18943.     16129.      9750.       708.        43.         0.         0.
 TOTAL X/Qs    41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
 % NON ZERO     33.62      37.65      43.84      53.28      60.77      76.11      98.22      99.89     100.00     100.00

 95th PERCENTILE X/Q VALUES
             6.94E-04   6.58E-04   6.07E-04   5.42E-04   4.27E-04   2.92E-04   1.79E-04   1.55E-04   1.33E-04   1.29E-04

 95% X/Q for standard averaging intervals

 0 to 2 hours       6.94E-04
 2 to 8 hours       4.91E-04
 8 to 24 hours      1.67E-04
 1 to 4 days        1.41E-04
 4 to 30 days       1.22E-04

                         HOURLY VALUE RANGE
                       MAX X/Q                  MIN X/Q
```

```
        CENTERLINE          8.96E-04                 2.05E-05
        SECTOR-AVERAGE      5.22E-04                 1.19E-05

NORMAL PROGRAM COMPLETION
```

Reactor Building Truck Lock to Control Room

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee       Phone: (301) 415 1080
                                e-mail: jyl1@nrc.gov
                J. J. Hayes     Phone: (301) 415 3167
                                e-mail: jjh@nrc.gov
                L. A  Brown     Phone: (301) 415 1232
                                e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell  Phone: (509) 372 6316
                                e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

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employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:06:33

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =      6.1
    Building Area (m^2)                  =   1382.0
    Effluent vertical velocity (m/s)     =      .00
    Vent or stack flow  (m^3/s)          =      .00
    Vent or stack radius (m)             =      .00
```

```
   Direction .. intake to source (deg)  =      315
   Wind direction sector width (deg)    =       90
   Wind direction window (deg)          =   270 - 360
   Distance to intake (m)               =     75.6
   Intake height  (m)                   =     15.2
   Terrain elevation difference (m)     =       .0

   Output file names
     pnps\rbtlcr1.log
     pnps\rbtlcr1.cfd

   Minimum Wind Speed (m/s)             =       .5
   Surface roughness length (m)         =       .20
   Sector averaging constant            =      4.3

   Initial value of sigma y             =       .00
   Initial value of sigma z             =       .00

   Expanded output for code testing not selected

   Total number of hours of data processed =  43848
   Hours of missing data                   =   1858
   Hours direction in window               =   8666
   Hours elevated plume w/ dir. in window  =      0
   Hours of calm winds                     =    142
   Hours direction not in window or calm   =  33182

   DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
  AVER. PER.          1          2          4          8         12         24         96        168        360        720
  UPPER LIM.   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02
    LOW LIM.   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06
 ABOVE RANGE         0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
    IN RANGE      8808.     10414.     12880.     16638.     20314.     27401.     38856.     38666.     37636.     38722.
 BELOW RANGE         0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
        ZERO     33182.     31361.     28477.     23906.     20797.     13406.      1028.        52.         0.         0.
  TOTAL X/Qs     41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
  % NON ZERO      20.98      24.93      31.14      41.04      49.41      67.15      97.42      99.87     100.00     100.00

   95th PERCENTILE X/Q VALUES
               9.72E-04   9.55E-04   9.05E-04   8.07E-04   6.46E-04   4.56E-04   2.59E-04   2.20E-04   1.95E-04   1.74E-04

   95% X/Q for standard averaging intervals

   0 to 2 hours        9.72E-04
   2 to 8 hours        7.52E-04
   8 to 24 hours       2.80E-04
   1 to 4 days         1.93E-04
   4 to 30 days        1.61E-04

                              HOURLY VALUE RANGE
                            MAX X/Q             MIN X/Q
```

```
         CENTERLINE           1.42E-03                1.38E-04
         SECTOR-AVERAGE       8.25E-04                8.05E-05

NORMAL PROGRAM COMPLETION
```

Reactor Building Truck Lock to Technical Support Center

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

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employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:07:15

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =      6.1
    Building Area (m^2)                  =   1382.0
    Effluent vertical velocity (m/s)     =      .00
    Vent or stack flow  (m^3/s)          =      .00
    Vent or stack radius (m)             =      .00
```

```
  Direction .. intake to source (deg)   =      310
  Wind direction sector width (deg)     =       90
  Wind direction window (deg)           =   265 - 355
  Distance to intake (m)                =    119.0
  Intake height  (m)                    =      3.0
  Terrain elevation difference (m)      =       .0

  Output file names
    pnps\rbtltscl.log
    pnps\rbtltscl.cfd

  Minimum Wind Speed (m/s)              =       .5
  Surface roughness length (m)          =       .20
  Sector averaging constant             =      4.3

  Initial value of sigma y              =       .00
  Initial value of sigma z              =       .00

  Expanded output for code testing not selected

  Total number of hours of data processed =  43848
  Hours of missing data                   =   1858
  Hours direction in window               =   9515
  Hours elevated plume w/ dir. in window  =      0
  Hours of calm winds                     =    142
  Hours direction not in window or calm   =  32333

  DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.           1          2          4          8         12         24         96        168        360        720
 UPPER LIM.    1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03
   LOW LIM.    1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07
ABOVE RANGE          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
   IN RANGE       9657.     11275.     13764.     17518.     21180.     28080.     38920.     38666.     37636.     38722.
BELOW RANGE          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
       ZERO      32333.     30500.     27593.     23026.     19931.     12727.       964.        52.         0.         0.
 TOTAL X/Qs      41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
 % NON ZERO       23.00      26.99      33.28      43.21      51.52      68.81      97.58      99.87     100.00     100.00

  95th PERCENTILE X/Q VALUES
               4.27E-04   4.21E-04   4.04E-04   3.65E-04   2.92E-04   2.07E-04   1.20E-04   1.03E-04   9.05E-05   8.00E-05

  95% X/Q for standard averaging intervals

  0 to 2 hours        4.27E-04
  2 to 8 hours        3.45E-04
  8 to 24 hours       1.27E-04
  1 to 4 days         9.13E-05
  4 to 30 days        7.39E-05

                            HOURLY VALUE RANGE
                          MAX X/Q              MIN X/Q
```

```
        CENTERLINE          6.07E-04                6.15E-05
        SECTOR-AVERAGE      3.54E-04                3.58E-05

  NORMAL PROGRAM COMPLETION
```

Reactor Building North Wall to Control Room

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee       Phone: (301) 415 1080
                                e-mail: jyl1@nrc.gov
                J. J. Hayes     Phone: (301) 415 3167
                                e-mail: jjh@nrc.gov
                L. A  Brown     Phone: (301) 415 1232
                                e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell  Phone: (509) 372 6316
                                e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

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liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:05:24

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =      2.0
    Building Area (m^2)                  =   1860.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00
```

```
  Direction .. intake to source (deg)   =      345
  Wind direction sector width (deg)     =       90
  Wind direction window (deg)           =   300 - 030
  Distance to intake (m)                =     45.0
  Intake height  (m)                    =     15.2
  Terrain elevation difference (m)      =       .0

  Output file names
    pnps\rbncr.log
    pnps\rbncr.cfd

  Minimum Wind Speed (m/s)              =       .5
  Surface roughness length (m)          =       .20
  Sector averaging constant             =      4.3

  Initial value of sigma y              =       .00
  Initial value of sigma z              =       .00

  Expanded output for code testing not selected

  Total number of hours of data processed =  43848
  Hours of missing data                   =   1858
  Hours direction in window               =   6839
  Hours elevated plume w/ dir. in window  =      0
  Hours of calm winds                     =    142
  Hours direction not in window or calm   =  35009

  DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.          1         2         4         8        12        24        96       168       360       720
 UPPER LIM.   1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02
   LOW LIM.   1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06
ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
   IN RANGE      6981.     8660.    10840.    14028.    17186.    23650.    37404.    38471.    37636.    38722.
BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       ZERO     35009.    33115.    30517.    26516.    23925.    17157.     2480.      247.        0.        0.
 TOTAL X/Qs     41990.    41775.    41357.    40544.    41111.    40807.    39884.    38718.    37636.    38722.
 % NON ZERO      16.63     20.73     26.21     34.60     41.80     57.96     93.78     99.36    100.00    100.00

  95th PERCENTILE X/Q VALUES
              2.36E-03  2.27E-03  2.01E-03  1.79E-03  1.44E-03  1.00E-03  5.79E-04  4.78E-04  4.22E-04  3.81E-04

  95% X/Q for standard averaging intervals

  0 to 2 hours        2.36E-03
  2 to 8 hours        1.60E-03
  8 to 24 hours       6.10E-04
  1 to 4 days         4.37E-04
  4 to 30 days        3.51E-04

                         HOURLY VALUE RANGE
                       MAX X/Q             MIN X/Q
```

```
         CENTERLINE         3.59E-03                2.86E-04
         SECTOR-AVERAGE     2.09E-03                1.67E-04

NORMAL PROGRAM COMPLETION
```

Reactor Building North Wall to Technical Support Center

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee       Phone: (301) 415 1080
                                e-mail: jyl1@nrc.gov
                J. J. Hayes     Phone: (301) 415 3167
                                e-mail: jjh@nrc.gov
                L. A  Brown     Phone: (301) 415 1232
                                e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell  Phone: (509) 372 6316
                                e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

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liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:05:46

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)   =     10.0
    Height of upper wind instrument (m)   =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                    =      2.0
    Building Area (m^2)                   =   1860.0
    Effluent vertical velocity (m/s)      =      .00
    Vent or stack flow  (m^3/s)           =      .00
    Vent or stack radius (m)              =      .00
```

```
Direction .. intake to source (deg)    =      325
Wind direction sector width (deg)      =       90
Wind direction window (deg)            =   280 - 010
Distance to intake (m)                 =     73.0
Intake height  (m)                     =      3.0
Terrain elevation difference (m)       =       .0

Output file names
  pnps\rbntsc.log
  pnps\rbntsc.cfd

Minimum Wind Speed (m/s)               =       .5
Surface roughness length (m)           =      .20
Sector averaging constant              =      4.3

Initial value of sigma y               =      .00
Initial value of sigma z               =      .00

Expanded output for code testing not selected

Total number of hours of data processed =  43848
Hours of missing data                   =   1858
Hours direction in window               =   7590
Hours elevated plume w/ dir. in window  =      0
Hours of calm winds                     =    142
Hours direction not in window or calm   =  34258

DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.          1         2         4         8        12        24        96       168       360       720
 UPPER LIM.   1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02  1.00E-02
   LOW LIM.   1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06  1.00E-06
ABOVE RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
   IN RANGE      7732.     9423.    11817.    15404.    18934.    26044.    38543.    38614.    37636.    38722.
BELOW RANGE         0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
       ZERO     34258.    32352.    29540.    25140.    22177.    14763.     1341.      104.        0.        0.
 TOTAL X/Qs     41990.    41775.    41357.    40544.    41111.    40807.    39884.    38718.    37636.    38722.
 % NON ZERO      18.41     22.56     28.57     37.99     46.06     63.82     96.64     99.73    100.00    100.00

 95th PERCENTILE X/Q VALUES
              1.04E-03  1.01E-03  9.24E-04  8.18E-04  6.55E-04  4.61E-04  2.54E-04  2.23E-04  1.96E-04  1.75E-04

 95% X/Q for standard averaging intervals

 0 to 2 hours        1.04E-03
 2 to 8 hours        7.44E-04
 8 to 24 hours       2.83E-04
 1 to 4 days         1.85E-04
 4 to 30 days        1.63E-04

                          HOURLY VALUE RANGE
                        MAX X/Q             MIN X/Q
```

```
         CENTERLINE        1.53E-03                 1.47E-04
         SECTOR-AVERAGE    8.91E-04                 8.59E-05

NORMAL PROGRAM COMPLETION
```

Turbine Building Reactor Feed Pump Area to Control Room

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell  Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

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employees, makes any warranty, expressed or implied, or assumes any legal
liability or responsibilities for any third party's use, or the results of such
use, of any portion of this program or represents that its use by such third
party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:08:58

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     18.0
    Building Area (m^2)                  =    406.0
    Effluent vertical velocity (m/s)     =      .00
    Vent or stack flow  (m^3/s)          =      .00
```

```
  Vent or stack radius (m)                   =       .00

  Direction .. intake to source (deg)        =      273
  Wind direction sector width (deg)          =       90
  Wind direction window (deg)                =    228 - 318
  Distance to intake (m)                     =     56.7
  Intake height  (m)                         =     15.2
  Terrain elevation difference (m)           =       .0

  Output file names
    pnps\rfpcr1.log
    pnps\rfpcr1.cfd

  Minimum Wind Speed (m/s)                   =       .5
  Surface roughness length (m)               =       .20
  Sector averaging constant                  =      4.3

  Initial value of sigma y                   =       .00
  Initial value of sigma z                   =       .00

  Expanded output for code testing not selected

  Total number of hours of data processed =  43848
  Hours of missing data                   =   1858
  Hours direction in window               =  13924
  Hours elevated plume w/ dir. in window  =      0
  Hours of calm winds                     =    142
  Hours direction not in window or calm   =  27924

  DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.          1          2          4          8         12         24         96        168        360        720
 UPPER LIM.   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02
   LOW LIM.   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06
ABOVE RANGE         0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
   IN RANGE     14066.     16006.     18791.     22606.     26284.     32620.     39386.     38718.     37636.     38722.
BELOW RANGE         0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
       ZERO     27924.     25769.     22566.     17938.     14827.      8187.       498.         0.         0.         0.
 TOTAL X/Qs     41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
 % NON ZERO      33.50      38.31      45.44      55.76      63.93      79.94      98.75     100.00     100.00     100.00

  95th PERCENTILE X/Q VALUES
              1.99E-03   1.95E-03   1.89E-03   1.77E-03   1.43E-03   1.03E-03   6.46E-04   5.83E-04   5.29E-04   4.91E-04

  95% X/Q for standard averaging intervals

  0 to 2 hours        1.99E-03
  2 to 8 hours        1.69E-03
  8 to 24 hours       6.67E-04
  1 to 4 days         5.17E-04
  4 to 30 days        4.67E-04

                           HOURLY VALUE RANGE
```

```
                          MAX X/Q                  MIN X/Q
      CENTERLINE         2.54E-03                 2.13E-04
      SECTOR-AVERAGE     1.48E-03                 1.24E-04

NORMAL PROGRAM COMPLETION
```

Turbine Building Reactor Feed Pump Area to Technical Support Center

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee       Phone: (301) 415 1080
                                e-mail: jyl1@nrc.gov
                J. J. Hayes     Phone: (301) 415 3167
                                e-mail: jjh@nrc.gov
                L. A  Brown     Phone: (301) 415 1232
                                e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell  Phone: (509) 372 6316
                                e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

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party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:09:21

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     18.0
    Building Area (m^2)                  =    406.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00
```

```
  Direction .. intake to source (deg)    =      285
  Wind direction sector width (deg)      =       90
  Wind direction window (deg)            =   240 - 330
  Distance to intake (m)                 =     91.4
  Intake height  (m)                     =      3.0
  Terrain elevation difference (m)       =       .0

  Output file names
    pnps\rfptscl.log
    pnps\rfptscl.cfd

  Minimum Wind Speed (m/s)               =       .5
  Surface roughness length (m)           =       .20
  Sector averaging constant              =      4.3

  Initial value of sigma y               =       .00
  Initial value of sigma z               =       .00

  Expanded output for code testing not selected

  Total number of hours of data processed =  43848
  Hours of missing data                   =   1858
  Hours direction in window               =  12701
  Hours elevated plume w/ dir. in window  =      0
  Hours of calm winds                     =    142
  Hours direction not in window or calm   =  29147

  DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.           1          2          4          8         12         24         96        168        360        720
 UPPER LIM.    1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03   1.00E-03
   LOW LIM.    1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07   1.00E-07
ABOVE RANGE         11.         4.         2.         1.         0.         0.         0.         0.         0.         0.
   IN RANGE      12832.     14696.     17365.     21109.     24718.     31260.     39255.     38708.     37636.     38722.
BELOW RANGE          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
       ZERO      29147.     27075.     23990.     19434.     16393.      9547.       629.        10.         0.         0.
 TOTAL X/Qs      41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
 % NON ZERO       30.59      35.19      41.99      52.07      60.13      76.60      98.42      99.97     100.00     100.00

  95th PERCENTILE X/Q VALUES
               7.73E-04   7.50E-04   7.21E-04   6.73E-04   5.47E-04   3.94E-04   2.38E-04   2.16E-04   1.96E-04   1.78E-04

  95% X/Q for standard averaging intervals

  0 to 2 hours        7.73E-04
  2 to 8 hours        6.40E-04
  8 to 24 hours       2.55E-04
  1 to 4 days         1.86E-04
  4 to 30 days        1.69E-04

                             HOURLY VALUE RANGE
                           MAX X/Q               MIN X/Q
```

```
        CENTERLINE          1.00E-03                8.67E-05
        SECTOR-AVERAGE      5.86E-04                5.06E-05

 NORMAL PROGRAM COMPLETION
```

Turbine Building to Control Room

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee        Phone: (301) 415 1080
                                 e-mail: jyl1@nrc.gov
                J. J. Hayes      Phone: (301) 415 3167
                                 e-mail: jjh@nrc.gov
                L. A  Brown      Phone: (301) 415 1232
                                 e-mail: lab2@nrc.gov

Code Developer: J. V. Ramsdell   Phone: (509) 372 6316
                                 e-mail: j_ramsdell@pnl.gov

Code Documentation:  NUREG/CR-6331 Rev. 1

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party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:10:24

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     25.9
    Building Area (m^2)                  =   2116.0
    Effluent vertical velocity (m/s)     =      .00
    Vent or stack flow  (m^3/s)          =      .00
    Vent or stack radius (m)             =      .00
```

```
      Direction .. intake to source (deg)  =      207
      Wind direction sector width (deg)    =       90
      Wind direction window (deg)          =   162 - 252
      Distance to intake (m)               =     42.1
      Intake height  (m)                   =     15.2
      Terrain elevation difference (m)     =       .0

      Output file names
        pnps\tbcr1.log
        pnps\tbcr1.cfd

      Minimum Wind Speed (m/s)             =       .5
      Surface roughness length (m)         =       .20
      Sector averaging constant            =      4.3

      Initial value of sigma y             =       .00
      Initial value of sigma z             =       .00

      Expanded output for code testing not selected

      Total number of hours of data processed =  43848
      Hours of missing data                   =   1858
      Hours direction in window               =  18033
      Hours elevated plume w/ dir. in window  =      0
      Hours of calm winds                     =    142
      Hours direction not in window or calm   =  23815

      DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
     AVER. PER.         1          2          4          8         12         24         96        168        360        720
     UPPER LIM.  1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02
       LOW LIM.  1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06
    ABOVE RANGE        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
       IN RANGE    18175.     20261.     23203.     27157.     30553.     35061.     39566.     38718.     37636.     38722.
    BELOW RANGE        0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
           ZERO    23815.     21514.     18154.     13387.     10558.      5746.       318.         0.         0.         0.
     TOTAL X/Qs    41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
     % NON ZERO     43.28      48.50      56.10      66.98      74.32      85.92      99.20     100.00     100.00     100.00

      95th PERCENTILE X/Q VALUES
                 3.56E-03   3.47E-03   3.35E-03   3.22E-03   2.65E-03   1.91E-03   1.30E-03   1.19E-03   1.07E-03   9.99E-04

      95% X/Q for standard averaging intervals

      0 to 2 hours        3.56E-03
      2 to 8 hours        3.11E-03
      8 to 24 hours       1.26E-03
      1 to 4 days         1.10E-03
      4 to 30 days        9.52E-04

                           HOURLY VALUE RANGE
                         MAX X/Q                 MIN X/Q
```

```
        CENTERLINE          4.17E-03                 2.44E-04
        SECTOR-AVERAGE      2.43E-03                 1.42E-04

NORMAL PROGRAM COMPLETION
```

Turbine Building to Technical Support Center

```
Program Title:  ARCON96.

Developed For:  U.S. Nuclear Regulatory Commission
                Office of Nuclear Reactor Regulation
                Division of Reactor Program Management

Date:           June 25, 1997    11:00 a.m.

NRC Contacts:   J. Y. Lee       Phone: (301) 415 1080
                                e-mail: jyl1@nrc.gov
                J. J. Hayes     Phone: (301) 415 3167
                                e-mail: jjh@nrc.gov
                L. A  Brown     Phone: (301) 415 1232
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Code Developer: J. V. Ramsdell  Phone: (509) 372 6316
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Code Documentation:  NUREG/CR-6331 Rev. 1

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party would not infringe privately owned rights.

Program Run  10/26/2004  at  09:11:36

 ******* ARCON INPUT **********

    Number of Meteorological Data Files  =  5
    Meteorological Data File Names
      C:\ARCON96\PNPS\PNPS96.MET
      C:\ARCON96\PNPS\PNPS97.MET
      C:\ARCON96\PNPS\PNPS98.MET
      C:\ARCON96\PNPS\PNPS99.MET
      C:\ARCON96\PNPS\PNPS00.MET

    Height of lower wind instrument (m)  =     10.0
    Height of upper wind instrument (m)  =     67.1
    Wind speeds entered as miles per hour

    Ground-level release
    Release height (m)                   =     25.9
    Building Area (m^2)                  =   2116.0
    Effluent vertical velocity (m/s)     =       .00
    Vent or stack flow  (m^3/s)          =       .00
    Vent or stack radius (m)             =       .00
```

```
  Direction .. intake to source (deg)    =       256
  Wind direction sector width (deg)      =        90
  Wind direction window (deg)            =    211 - 301
  Distance to intake (m)                 =      57.9
  Intake height  (m)                     =       3.0
  Terrain elevation difference (m)       =        .0

  Output file names
    pnps\tbtscl.log
    pnps\tbtscl.cfd

  Minimum Wind Speed (m/s)               =        .5
  Surface roughness length (m)           =        .20
  Sector averaging constant              =       4.3

  Initial value of sigma y               =        .00
  Initial value of sigma z               =        .00

  Expanded output for code testing not selected

  Total number of hours of data processed =  43848
  Hours of missing data                   =   1858
  Hours direction in window               =  16112
  Hours elevated plume w/ dir. in window  =      0
  Hours of calm winds                     =    142
  Hours direction not in window or calm   =  25736

  DISTRIBUTION SUMMARY DATA BY AVERAGING INTERVAL
 AVER. PER.           1          2          4          8         12         24         96        168        360        720
 UPPER LIM.    1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02   1.00E-02
   LOW LIM.    1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06   1.00E-06
ABOVE RANGE          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
   IN RANGE      16254.     18480.     21654.     25941.     29691.     35234.     39555.     38718.     37636.     38722.
BELOW RANGE          0.         0.         0.         0.         0.         0.         0.         0.         0.         0.
       ZERO      25736.     23295.     19703.     14603.     11420.      5573.       329.         0.         0.         0.
 TOTAL X/Qs      41990.     41775.     41357.     40544.     41111.     40807.     39884.     38718.     37636.     38722.
 % NON ZERO       38.71      44.24      52.36      63.98      72.22      86.34      99.18     100.00     100.00     100.00

  95th PERCENTILE X/Q VALUES
               1.72E-03   1.71E-03   1.68E-03   1.58E-03   1.28E-03   9.05E-04   5.99E-04   5.39E-04   4.69E-04   4.35E-04

  95% X/Q for standard averaging intervals

  0 to 2 hours        1.72E-03
  2 to 8 hours        1.54E-03
  8 to 24 hours       5.67E-04
  1 to 4 days         4.96E-04
  4 to 30 days        4.10E-04

                             HOURLY VALUE RANGE
                           MAX X/Q               MIN X/Q
```

```
        CENTERLINE          2.08E-03                1.64E-04
        SECTOR-AVERAGE      1.21E-03                9.57E-05

NORMAL PROGRAM COMPLETION
```

20032-33 (6/23/2004)

AREVA

DOCUMENT RELEASE NOTICE

RELEASE DATE
11/4/04

RM INITIALS

CONTRACT NUMBER 4170698	PLANT Pilgrim Nuclear Power Station	CC OR CHARGE NUMBER 4170698	PAGE 1 OF 1

PART OR TASK No. (N/A If Not Applicable)	DOCUMENT NUMBER	DOCUMENT TITLE	SAFETY CLASS. (S/NS)	PUL (Y/N)	COLD (Y/N)	COM (Y/N)
N/A	32-5052036-00	Evaluation of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data	S	N	Y	N

KEYWORDS (For Informational Purposes Only)
Meteorology, metrose

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20697-8 (4/1/2004)

AREVA

CALCULATION SUMMARY SHEET (CSS)

Document Identifier 32-5052036-00

Title Evaluation of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data

PREPARED BY:

NAME Theodore A. Messier

SIGNATURE Theodore A. Messier

TITLE Meteorologist DATE 10-20-04

COST CENTER 41758 REF. PAGE(S) 10-11

REVIEWED BY:

METHOD: ☒ DETAILED CHECK ☐ INDEPENDENT CALCULATION

NAME John N. Hamawi

SIGNATURE John Hamawi 11/3/04

TITLE Consulting Radiological Eng. DATE

TM STATEMENT: REVIEWER INDEPENDENCE

PURPOSE AND SUMMARY OF RESULTS:

Purpose

Evaluate the meteorological data recorded by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station from January 1996 through December 2001.

Results

Meteorological data recorded on the 220' primary tower by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station (PNPS) from January 1996 through December 2001 were evaluated. These data were determined to be of good quality and suitable for use in atmospheric dispersion assessments.

This calculation is safety related and was prepared under the AREVA/Framatome ANP Quality Assurance Program.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV	CODE/VERSION/REV
metrose version 1.3	

THE DOCUMENT CONTAINS ASSUMPTIONS THAT MUST BE VERIFIED PRIOR TO USE ON SAFETY-RELATED WORK

☐ YES ☒ NO

22410-3 (5/10/2004) *1 of 2*

AREVA

DESIGN VERIFICATION CHECKLIST

Document Identifier 32-5052036-00 - Page 2 of 32

Title Evaluation of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data

1.	Were the inputs correctly selected and incorporated into design or analysis?	☑ Y	☐ N	☐ N/A
2.	Are assumptions necessary to perform the design or analysis activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent re-verifications when the detailed design activities are completed?	☑ Y	☐ N	☐ N/A
3.	Are the appropriate quality and quality assurance requirements specified? Or, for documents prepared per FANP procedures, have the procedural requirements been met?	☑ Y	☐ N	☐ N/A
4.	If the design or analysis cites or is required to cite requirements or criteria based upon applicable codes, standards, specific regulatory requirements, including issue and addenda, are these properly identified, and are the requirements/criteria for design or analysis met?	☐ Y	☐ N	☑ N/A
5.	Have applicable construction and operating experience been considered?	☐ Y	☐ N	☑ N/A
6.	Have the design interface requirements been satisfied?	☐ Y	☐ N	☑ N/A
7.	Was an appropriate design or analytical method used?	☑ Y	☐ N	☐ N/A
8.	Is the output reasonable compared to inputs?	☑ Y	☐ N	☐ N/A
9.	Are the specified parts, equipment and processes suitable for the required application?	☐ Y	☐ N	☑ N/A
10.	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?	☐ Y	☐ N	☑ N/A
11.	Have adequate maintenance features and requirements been specified?	☐ Y	☐ N	☑ N/A
12.	Are accessibility and other design provisions adequate for performance of needed maintenance and repair?	☐ Y	☐ N	☑ N/A
13.	Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?	☐ Y	☐ N	☑ N/A
14.	Has the design properly considered radiation exposure to the public and plant personnel?	☐ Y	☐ N	☑ N/A
15.	Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?	☐ Y	☐ N	☑ N/A
16.	Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?	☐ Y	☐ N	☑ N/A
17.	Are adequate handling, storage, cleaning and shipping requirements specified?	☐ Y	☐ N	☑ N/A
18.	Are adequate identification requirements specified?	☐ Y	☐ N	☑ N/A
19.	Is the document prepared and being released under the FANP Quality Assurance Program? If not, are requirements for record preparation review, approval, retention, etc., adequately specified?	☑ Y	☐ N	☐ N/A

AREVA

DESIGN VERIFICATION CHECKLIST

Document Identifier: 32-5052036-00 - Page 3 of 32

Comments:

Verified By: John N. Hamawi John Hamawi 11/3/04
(First, MI, Last) Printed / Typed Name Signature Date

RECORD OF REVISIONS

Place holder for future revisions, if any.

TABLE OF CONTENTS

1.0 Purpose/Objective

Evaluate the meteorological data recorded by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station (PNPS) from January 1996 through December 2001 as requested in Entergy/Pilgrim Contract Order Number 4500534887.

2.0 Assumptions and Key Assumptions

Since the base of the backup meteorological tower is not located on a natural surface, it was assumed that the data from that tower were not suitable for use in this calculation.

A key assumption is any assumption or limitation that must be verified prior to using the results and/or conclusions of a calculation for a safety-related task. There are no key assumptions in the present calculation.

3.0 Computing Environment

The computer runs in this calculation involved the use of pnpswd, becheck, and metrose and were carried out on the HP 9000/785 CPU running the HP UX B.10.20 operating system. Computer programs pnpswd and becheck were written expressly for use in this calculation and their usage is validated in Attachment A. Computer code metrose is listed in the Framatome-ANP Computer Software Index. It is a safety-related computer code used to produce joint frequency distribution (JFD) summaries of meteorological data. There are no open software error reports for metrose.

4.0 Quality Assurance

This work was performed under Framatome's Quality Assurance Program, and Framatome Procedure 0402-01 (Preparing and Processing FANP Calculations) was followed.

5.0 Calculations

Meteorological data recorded by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station from January 1996 through December 2001 were retrieved from the Framatome-ANP (FANP) Software Control Library in the form of annual files. These data had been used previously to generate annual joint frequency distribution tables for PNPS (see References 2 through 10), were in the BECo met data format (see Exhibit 1), and included data from both meteorological towers (the 220' primary and the 160' backup). These annual data files were transmitted to PNPS and were compared to those in their possesion and were found to be identical.

Although these data had been checked previously by both PNPS and YNSD or DE&S (now AREVA/FANP), it was decided to check the data again. Computer program becheck was written to perform this data check and to determine the data recovery rates. Each of the original six annual meteorological data files were input in turn to becheck.

Program becheck checked for the following suspicious data:

- Unstable delta-temperature values at night,
- Stable delta-temperature values all day long,

- Ambient temperature changes of ten degrees Fahrenheit or more in an hour's time,
- Repeating wind speed values, and
- Comparison of primary tower to backup tower wind direction values.

Note that data flagged by the program were not necessarily bad data – the program simply flags data worthy of a closer look by an experienced meteorologist (indeed, the NRC computer code QA works under the same philosophy). Since the backup tower data were considered suspect and not used in this calculation, the results of the wind direction comparison were ignored. Note that while some data were flagged, it is the opinion of the author, a meteorologist with seventeen years experience, that the data are correct given the atmospheric conditions occurring when they were recorded and the location of PNPS on the shore of Massachusetts Bay. Computer input and output file names are listed in Attachment B; copies of these files were provided on a compact disc to PNPS and were put on the FANP COLD Server for archival storage. A listing of computer code becheck is presented in Attachment D. The source code file name is becheck.f and the executable file name is becheck.e. The file sizes in bytes and the creation date/time are:

```
permissions   file owner    group      size in bytes  date/time     file name
-rwxrwxrwx   messier      eed            49245 Oct  5 14:51 becheck.e
-rw-r-----   messier      eed            12142 Oct  5 14:50 becheck.f
```

As an additional check of the data, the FANP computer code metrose was used to produce a joint frequency distribution summary of the 1996-2001 meteorological data. This JFD was compared to two others produced from PNPS meteorological data from 1992 (Reference 11) and 1993 (Reference 12). This comparison of the 1996-2001 data set with historical data from the site showed good agreement. A summary of the comparison is provided in Table 1. Data recovery rates for the 1996-2001 period are provided in Table 2. Computer input and output file names are listed in Attachment B; copies of these files were provided on a compact disc to PNPS and were put on the FANP COLD Server for archival storage.

A joint frequency distribution summary of the 1996-2000 meteorological data was produced using the FANP computer code metrose. This JFD is suitable for inclusion in a PAVAN input file for use in generating atmospheric dispersion factors for accident conditions.

Visual examination of the data files indicated that the 1996 data file had wind direction values that ranged from 0 degrees to 540 degrees. The other annual files had wind direction values that ranged from 0 degrees to 360 degrees. For the sake of consistency, it was decided to convert all wind direction values from 0 to 540 degrees to 0 to 360 degrees. Computer code pnpswd was written to perform this conversion.

Each of the six annual meteorological files were input to pnpswd and two files were output in each of the six runs: the so-called banner file which lists the computer code name, version number, input file name, number of wind direction values changed, and run date, the main output file of meteorological data with wind direction values converted as necessary. Note that the computer code checked for wind direction values that were greater than 360 degrees but less than 541 degrees so as to not affect any data flagged as bad or missing (9999). The primary tower meteorological data were output by pnpswd but the backup tower meteorological data were not. Otherwise, the original BECo met data format was maintained (see Exhibit 1). Computer input and output file names are listed in Attachment B; copies of these files were provided on a compact disc to PNPS and were put on the FANP COLD Server for archival storage. A listing of computer code pnpswd is presented in Attachment C. The source code file name is pnpswd.f and the executable file name is pnpswd.e. The file sizes in bytes and the creation date/time are:

```
permissions   file owner   group    size in bytes  date/time      file name
-rwxrwxrwx    1 messier    eed            28763 Oct 19 08:44 pnpswd.e
-rw-r-----    1 messier    eed             4518 Oct 19 08:44 pnpswd.f
```

Exhibit 2 presents the PNPS atmospheric stability classes as a function of delta-temperature values (degrees Fahrenheit per 187 feet). This exhibit also contains the stability class breakdown (used by the NRC in Safety Guide 23) in degrees Celsius per 100 meters, and documents the conversion from degrees Celsius per 100 meters to degrees Fahrenheit per 187 feet.

Table 1: Summary of Joint Frequency Distribution Comparison

Stability Class	1996-2001	
	33' winds	220' winds
A	13	12.89
B	3.39	3.4
C	4.51	4.53
D	30.35	30.41
E	35.25	35.32
F	10.57	10.56
G	2.93	2.89

Major WS Class	4-7 MPH	13-18 MPH
Major WD	SSW	SSW

Stability Class	1992	
	33' winds	220' winds
A	9.89	9.88
B	3	2.99
C	3.63	3.64
D	29.25	29.44
E	32.56	32.64
F	17.49	17.38
G	4.17	4.04

Major WS Class	4-7 MPH	13-18 MPH
Major WD	SSW	SSW

Source: Reference 11

Stability Class	1993	
	33' winds	220' winds
A	10.1	10.23
B	3.98	4.01
C	4.95	5.09
D	37.86	37.66
E	31.69	31.91
F	9.45	9.22
G	1.96	1.88

Major WS Class	4-7 MPH	13-18 MPH
Major WD	SSW	SSW

Source: Reference 12

Table 2: Meteorological Data Recovery Rates for the Period 1996-2001

Year	Data Recovery Rates	
	LL Composite	UL Composite
1996	96.82	95.99
1997	93.73	95.40
1998	96.71	92.05
1999	94.77	90.82
2000	91.85	91.02
2001	95.76	97.05
Six Year Average	94.94	93.72

Note that the composite recovery reported is the percent of time that wind speed, wind direction, and delta temperature were available simultaneously.

6.0 Results/Conclusion

Meteorological data recorded on the 220' primary tower by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station (PNPS) from January 1996 through December 2001 were evaluated. These data were determined to be of good quality and suitable for use in atmospheric dispersion assessments.

7.0 References

1. Entergy/Pilgrim Contract Order Number 4500534887.
2. AREVA/FANPCalculation BEC-0081, Rev. 0, "Pilgrim Station Meteorological Data Joint Frequency Distributions First and Second Quarters 1996", dated 7/25/1996.
3. AREVA/FANPCalculation BEC-0085, Rev. 0, "Pilgrim Station Meteorological Data Joint Frequency Distributions Third and Fourth Quarters 1996", dated 2/12/1997.
4. AREVA/FANPCalculation BEC-0086, Rev. 0, "Pilgrim Station Meteorological Data Joint Frequency Distributions First and Second Quarters 1997", dated 8/6/1997.
5. AREVA/FANP Calculation BEC-0088, Rev. 0, "Pilgrim Station Meteorological Data Joint Frequency Distributions Third and Fourth Quarters 1997", dated 2/10/1998.
6. AREVA/FANP Calculation EHS-BEC-001, Rev. 0, "Pilgrim Station Meteorological Data Joint Frequency Distributions First and Second Quarters 1998", dated 8/12/1998.
7. AREVA/FANP Calculation BEC-0090, Rev. 0, "Pilgrim Station Meteorological Data Joint Frequency Distributions Third and Fourth Quarters 1998", dated 3/26/1999.
8. AREVA/FANP Calculation BEC-0091, Rev. 0, "Pilgrim Station Meteorological Data Joint Frequency Distributions First, Second, Third, and Fourth Quarters 1999", dated 3/20/2000.
9. AREVA/FANP Calculation BEC-0093, Rev. 0, "Pilgrim Station Meteorological Data Joint Frequency Distributions First, Second, Third, and Fourth Quarters 2000", dated 4/13/2001.
10. AREVA/FANP Calculation BEC-0095, Rev. 0, "Pilgrim Station Meteorological Data Joint Frequency Distributions First, Second, Third, and Fourth Quarters 2001", dated 4/16/2002.

11. AREVA/FANPCalculation BEC-0063, Rev. 0, "Generation of Brookhaven National Laboratory-Format Joint Frequency Distributions, 1992", dated 8/30/1993.
12. AREVA/FANPCalculation BEC-0070, Rev. 0, "Generation of Brookhaven National Laboratory-Format Joint Frequency Distributions, 1993", dated 2/10/1994.

Exhibit 1: BECo Meteorological Data Format

Parameter (units)	# of Chars.	Columns
Year	2	01-02
Month	2	04-05
Day	2	07-08
Hour	2	10-11
160 Foot Tower:		
Wind Direction; 160 ft (degrees from)	4	15-18
Wind Speed; 160 ft (tenths of mph)	4	20-23
Wind Direction; 33 ft (degrees from)	4	25-28
Wind Speed; 33 ft (tenths of mph)	4	30-33
Temperature; 33 ft (degrees F)	4	35-38
Delta T; 160-33 ft (Tenths of degrees F)	4	40-43
220 Foot Tower:		
Wind Direction; 220 ft (degrees from)	4	50-53
Wind Speed; 220 ft (tenths of mph)	4	55-58
Wind Direction; 33 ft (degrees from)	4	60-63
Wind Speed; 33 ft (tenths of mph)	4	65-68
Temperature; 33 ft (degrees F)	4	70-73
Delta T; 220-33 ft (Tenths of degrees F)	4	75-78

(See Attachment A of Reference 3)

Exhibit 2: PNPS Delta-Temperature Ranges (Stability Classes)

Stability Class	Temperature Gradient * °C/100m	Delta-Temperature °F/187'	Delta-Temperature per 130'
A	T <= -1.9	T <=-1.95	T <=-1.32
B	-1.9 > T <= -1.7	-1.95 > T <= -1.74	-1.32 > T <= -1.18
C	-1,7 > T <= -1.5	-1.74 > T <= -1.54	-1.18 > T <= -1.05
D	-1.5 > T <= -0.5	-1.54 > T <= -0.51	-1.05 > T <= -0.35
E	-0.5 > T <= 1.5	-0.51 > T <= 1.54	-0.35 > T <= 1.05
F	1.5 > T <= 4.0	1.54 > T <= 4.1	1.05 > T <= 2.79
G	T > 4.0	T > 4.1	T > 2.79

* From ANSI/ANS-2.5-1984, "American Standard for Determining Meteorological Information at Nuclear Power Sites", dated 9/14/1984.

ATTACHMENT A: Validation of Computer Codes pnpswd and becheck

Computer code pnpswd was written to find wind direction values greater than 360 degrees and less than 541 degrees and convert them to the appropriate value in the 0-360 degree range. In addition, pnpswd outputs only the data from the 220' tower.

To test that the code functioned properly, some data were compared between the input and output files:

Original 1996 Meteorological Data

YR	MN	DY	HR	BUWD	BUWS	BLWD	BLWS	BT	BDT	UWD	UWS	LWD	LWS	TEMP	DT
96	1	1	0	280	59	246	34	32	21	299	78	241	32	33	25
96	1	1	1	307	78	268	47	33	15	310	106	276	41	32	23
96	1	1	2	312	66	273	40	32	8	310	89	265	35	33	10
96	1	1	3	323	63	285	42	33	3	331	94	265	33	33	16
96	1	1	4	329	78	299	53	33	3	329	105	282	42	33	9
96	1	1	5	329	82	298	52	33	3	328	103	295	37	32	12
96	1	1	6	332	64	304	48	33	2	328	81	299	33	33	4
96	1	1	7	317	53	301	42	33	1	304	89	278	50	33	1
96	1	1	8	299	68	268	46	33	-1	311	101	269	28	33	-2
96	1	1	9	324	97	308	65	34	-7	327	126	295	53	36	-16
96	1	1	10	263	139	253	120	35	-6	365	181	353	93	35	-13
96	1	1	11	61	154	51	155	34	-5	409	178	391	89	35	-12
96	1	1	12	73	73	63	84	33	-4	425	142	425	74	34	-12
96	1	1	13	85	38	73	45	33	-3	437	102	426	62	34	-11
96	1	1	14	72	72	62	77	33	-5	424	131	427	76	34	-11
96	1	1	15	70	75	61	82	32	-5	416	132	409	72	33	-11
96	1	1	16	73	50	63	61	31	-3	422	120	418	65	32	-12
96	1	1	17	81	33	70	46	31	-4	428	114	422	78	32	-10
96	1	1	18	87	45	79	51	31	-5	441	94	427	49	32	-10
96	1	1	19	107	75	101	60	31	-5	456	100	456	52	32	-9
96	1	1	20	117	62	114	41	31	-4	459	75	204	27	32	-7
96	1	1	21	118	63	114	39	31	-4	473	85	179	37	32	-7
96	1	1	22	137	84	133	44	31	-2	478	116	100	47	32	-7
96	1	1	23	146	78	131	41	31	-2	493	121	134	31	32	-7

Processed 1996 Meteorological Data

YR	MN	DY	HR	UWD	UWS	LWD	LWS	TEMP	DT
96	1	1	0	299	78	241	32	33	25
96	1	1	1	310	106	276	40	32	22
96	1	1	2	310	88	265	35	33	10
96	1	1	3	331	93	265	32	33	16
96	1	1	4	329	105	282	41	33	8
96	1	1	5	328	103	295	37	32	12
96	1	1	6	328	81	299	32	33	4
96	1	1	7	304	88	278	50	33	1
96	1	1	8	311	101	269	27	33	-2
96	1	1	9	327	126	295	53	36	-16
96	1	1	10	5	181	353	93	35	-12
96	1	1	11	49	177	31	88	35	-12
96	1	1	12	65	141	65	74	34	-12
96	1	1	13	77	101	66	61	34	-11
96	1	1	14	64	131	67	75	34	-11
96	1	1	15	56	131	49	71	33	-11
96	1	1	16	62	120	58	65	32	-12

```
96  1  1 17                                                68  113   62   78   32  -10
96  1  1 18                                                81   93   67   49   32  -10
96  1  1 19                                                96  100   96   51   32   -8
96  1  1 20                                                99   75  204   27   32   -6
96  1  1 21                                               113   85  179   37   32   -6
96  1  1 22                                               118  116  100   46   32   -6
96  1  1 23                                               133  121  134   30   32   -6
```

Original 2000 Meteorological Data

```
YR MN DY HR   BUWD BUWS BLWD BLWS   BT  BDT       UWD  UWS  LWD  LWS TEMP   DT
00 12 28 00    229  -10  260   67   20   -4       263  173  258   73   22   -6
00 12 28 01    251  -11  278  109   20   -5       273  221  265   89   22   -6
00 12 28 02    260  -11  284  105   20   -6       278  224  268   91   21   -6
00 12 28 03    255  -11  280  109   20   -6       277  221  268   93   21   -7
00 12 28 04    228  -11  267   64   19   -5       270  163  258   66   20   -5
00 12 28 05    227  -11  265   56   18   -3       266  160  255   68   20   -5
00 12 28 06    222  -11  254   50   17   -3       261  155  251   59   19   -5
00 12 28 07    215  -11  254   59   18   -4       259  168  252   65   19   -7
00 12 28 08    238  -11  274  108   19   -8       267  205  263   90   20  -11
00 12 28 09    245  -11  281  120   21  -10      9999 9999 9999 9999 9999 9999
00 12 28 10   9999 9999 9999 9999 9999 9999      9999 9999 9999 9999 9999 9999
00 12 28 11   9999 9999 9999 9999 9999 9999       286  242  279   99   24  -25
00 12 28 12   9999 9999 9999 9999 9999 9999       296  259  291  104   24  -25
00 12 28 13   9999 9999 9999 9999 9999 9999       288  262  282  107   22  -22
00 12 28 14    287  -10  297  107   22  -15       293  244  286   98   22  -19
```

Processed 2000 Meteorological Data

```
YR MN DY HR                                       UWD  UWS  LWD  LWS TEMP   DT
 0 12 28  0                                       263  172  258   73   22   -6
 0 12 28  1                                       273  221  265   88   22   -6
 0 12 28  2                                       278  223  268   91   21   -6
 0 12 28  3                                       277  221  268   93   21   -6
 0 12 28  4                                       270  162  258   65   20   -5
 0 12 28  5                                       266  160  255   68   20   -5
 0 12 28  6                                       261  155  251   59   19   -5
 0 12 28  7                                       259  167  252   65   19   -6
 0 12 28  8                                       267  205  263   90   20  -11
 0 12 28  9                                      9999 9999 9999 9999 9999 9999
 0 12 28 10                                      9999 9999 9999 9999 9999 9999
 0 12 28 11                                       286  242  279   98   24  -25
 0 12 28 12                                       296  258  291  103   24  -25
 0 12 28 13                                       288  262  282  106   22  -22
 0 12 28 14                                       293  243  286   98   22  -18
```

From this it can be seen that computer code pnpswd changed only the appropriate wind direction values and did not output the 160' tower data. (Note that the one-digit vs. two-digit output of the year 2000 is not significant as long as the one-digit is right-justified.)

Computer code becheck was written to find suspicious meteorological data values. In addition, becheck output the meteorological data recovery.

To test that the code functioned properly, some data were compared from the input and output files:

2001 Meteorological Data

YR	MN	DY	HR	BUWD	BUWS	BLWD	BLWS	BT	BDT	UWD	UWS	LWD	LWS	TEMP	DT
01	11	22	17	191	58	172	15	44	37	192	68	210	9	45	21
01	11	22	18	206	51	175	11	44	28	220	91	199	12	45	19
01	11	22	19	323	16	211	13	40	54	253	48	277	3	43	23
01	11	22	20	67	18	211	17	40	66	66	31	227	3	44	19
01	11	22	21	89	30	201	16	40	65	85	43	165	3	45	16
01	11	22	22	130	44	194	21	41	58	108	52	171	3	45	21
01	11	22	23	105	25	216	10	41	53	98	46	262	3	44	23
01	11	23	00	31	27	234	16	40	46	55	45	260	3	43	26
01	11	23	01	29	43	213	8	40	51	45	69	289	3	44	16
01	11	23	02	39	90	347	53	44	20	45	96	30	8	45	8
01	11	23	03	44	104	49	89	47	-8	46	106	42	12	46	-3

Wind Speed Values Flagged

```
          BECO PRIMARY TOWER SUSPECT WIND SPEED DATA

  1 11 22 23    .3 LL WS SENSOR MAY BE STUCK
```

This indicates that repeating wind speed values were flagged.

1997 Meteorological Data

YR	MN	DY	HR	BUWD	BUWS	BLWD	BLWS	BT	BDT	UWD	UWS	LWD	LWS	TEMP	DT
97	2	27	22	227	172	216	101	55	-9	236	216	217	84	55	-3
97	2	27	23	307	123	291	78	40	-15	310	149	274	46	40	3
97	2	28	0	307	83	295	53	41	-12	309	110	278	37	41	4

Ambient Temperature Values Flagged

```
          BECO PRIMARY TOWER SUSPECT TEMP. DATA

 97  1  9 12    44. TEMP. CHANGE > 10 DEG F !!!!!

 97  1  9 13    32. TEMP. CHANGE > 10 DEG F !!!!!

 97  2 27 23    40. TEMP. CHANGE > 10 DEG F !!!!!

 97  4  2 11    42. TEMP. CHANGE > 10 DEG F !!!!!

 97  7 18 21    66. TEMP. CHANGE > 10 DEG F !!!!!

 97  9 20 19    62. TEMP. CHANGE > 10 DEG F !!!!!

 97 11 17  7    26. TEMP. CHANGE > 10 DEG F !!!!!
```

This indicates that ambient temperature changes equal to or greater than ten degrees Fahrenheit were flagged.

2001 Meteorological Data

YR	MN	DY	HR	BUWD	BUWS	BLWD	BLWS	BT	BDT	UWD	UWS	LWD	LWS	TEMP	DT
01	01	20	18	73	9999	57	216	33	-14	49	272	42	118	34	-21
01	01	20	19	68	9999	52	237	32	-13	45	270	39	126	33	-19
01	01	20	20	74	9999	54	227	32	-12	48	278	42	122	33	-17
01	01	20	21	64	9999	45	252	31	-13	37	273	35	132	33	-12
01	01	20	22	63	9999	48	258	31	-12	40	307	37	141	33	-17
01	01	20	23	61	9999	46	270	31	-11	37	283	33	133	33	-17
01	06	28	00	261	163	252	92	76	-2	260	210	9999	76	9999	9999
01	06	28	01	265	176	255	101	75	-1	263	219	9999	81	9999	9999
01	06	28	02	264	167	254	99	75	-2	263	219	9999	79	9999	9999
01	06	28	03	269	161	255	87	74	-2	268	223	9999	77	9999	9999
01	06	28	04	269	161	262	79	74	-3	268	223	9999	75	9999	9999
01	06	28	05	275	169	272	84	75	-5	275	233	9999	71	9999	9999
01	06	28	06	281	132	279	79	76	-10	280	194	9999	59	9999	9999
01	06	28	07	299	108	302	78	78	-13	295	165	9999	50	9999	9999
01	06	28	08	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999	9999
01	06	28	09	9999	9999	9999	9999	9999	9999	335	221	340	41	75	25
01	06	28	10	9999	9999	9999	9999	9999	9999	335	181	332	40	75	25
01	06	28	11	9999	9999	9999	9999	9999	9999	336	131	340	34	77	-3
01	06	28	12	9999	9999	9999	9999	9999	9999	340	225	333	40	77	24
01	06	28	13	350	135	324	53	76	5	339	201	299	38	75	32
01	06	28	14	345	99	327	42	77	1	331	148	295	30	76	20
01	06	28	15	339	129	349	60	78	13	324	206	319	36	78	28
01	06	28	16	353	188	348	79	76	20	339	226	306	35	75	31
01	06	28	17	348	209	348	95	74	23	333	257	319	41	73	41
01	06	28	18	337	142	326	67	74	18	322	199	289	29	72	44
01	06	28	19	325	167	314	77	75	14	314	226	299	42	73	34
01	06	28	20	324	167	310	90	75	9	316	213	290	39	72	30
01	06	28	21	330	160	315	90	73	8	322	197	301	38	71	25
01	06	28	22	351	154	343	81	70	12	341	204	339	37	68	27
01	06	28	23	359	111	340	51	67	5	352	160	337	24	65	31

Delta-Temperature Values Flagged

```
          BECO PRIMARY TOWER SUSPECT DELTA-T DATA

 1  1 20 20  -1.7 UNSTABLE VALUE AT NIGHT

 1  1 20 22  -1.7 UNSTABLE VALUE AT NIGHT

 1  1 20 23  -1.7 UNSTABLE VALUE AT NIGHT

 1  6 28  STABLE ALL DAY
```

This indicates that delta- temperature values in the unstable range during the night were flagged and that days in which the delta- temperature values were in the stable range all day were flagged.

ATTACHMENT B: COMPUTER INPUT AND OUTPUT FILES .

The following computer runs were carried out for this calculation:

becheck

1996 PNPS 1996 meteorological data; input file bemet96; output files 1996.dr, 1996.ws, 1996.dt, 1996.at, 1996.wd

1997 PNPS 1997 meteorological data; input file bemet97; output files 1997.dr, 1997.ws, 1997.dt, 1997.at, 1997.wd

1998 PNPS 1998 meteorological data; input file bemet98; output files 1998.dr, 1998.ws, 1998.dt, 1998.at, 1998.wd

1999 PNPS 1999 meteorological data; input file bemet99; output files 1999.dr, 1999.ws, 1999.dt, 1999.at, 1999.wd

2000 PNPS 2000 meteorological data; input file bemet96.new; output files 2000.dr, 2000.ws, 2000.dt, 2000.at, 2000.wd

2001 PNPS 2001 meteorological data; input file bemet96.new; output files 2001.dr, 2001.ws, 2001.dt, 2001.at, 2001.wd

pnpswd

1996 PNPS 1996 meteorological data; input file bemet96.new; output files pnpswd.banner.96 and bemet96.new

1997 PNPS 1997 meteorological data; input file bemet97.new; output files pnpswd.banner.97 and bemet97.new

1998 PNPS 1998 meteorological data; input file bemet98.new; output files pnpswd.banner.98 and bemet98.new

1999 PNPS 1999 meteorological data; input file bemet99.new; output files pnpswd.banner.99 and bemet99.new

2000 PNPS 2000 meteorological data; input file bemet00.new; output files pnpswd.banner.00 and bemet00.new

2001 PNPS 2001 meteorological data; input file bemet01.new; output files pnpswd.banner.01 and bemet01.new

metrose

Lower Level	PNPS 1996-2001 meteorological data (33' wind speed and direction); input files beinl9601.m3 and bemet96.new, bemet97.new, bemet98.new, bemet99.new, bemet00.new, bemet01.new; output file bell9601.out
Upper Level	PNPS 1996-2001 meteorological data (220' wind speed and direction); input files beinu9601.m3 and bemet96.new, bemet97.new, bemet98.new, bemet99.new, bemet00.new, bemet01.new; output file beul9601.out
Lower Level	PNPS 1996-2000 meteorological data (33' wind speed and direction); input files beinl9600.m3 and bemet96.new, bemet97.new, bemet98.new, bemet99.new, bemet00.new; output file bell9600.out
Upper Level	PNPS 1996-2000 meteorological data (220' wind speed and direction); input files beinu9600.m3 and bemet96.new, bemet97.new, bemet98.new, bemet99.new, bemet00.new; output file beul9600.out

Listing of Files Included on the Compact Disc and Transferred to the FANP COLD Server for Archival Storage

File Size in Bytes	Date	Time	File Name	File Description
169	Oct 19	09:27	pnpswd.banner.00	banner output for pnpswd using 2000 data
169	Oct 19	09:27	pnpswd.banner.01	banner output for pnpswd using 2001 data
169	Oct 19	09:26	pnpswd.banner.96	banner output for pnpswd using 1996 data
169	Oct 19	09:27	pnpswd.banner.97	banner output for pnpswd using 1997 data
169	Oct 19	09:27	pnpswd.banner.98	banner output for pnpswd using 1998 data
169	Oct 19	09:27	pnpswd.banner.99	banner output for pnpswd using 1999 data
693984	Oct 4	09:53	bemet00	original 2000 met data
693984	Oct 19	09:27	bemet00.new	2000 met data from pnpswd
692088	Oct 4	09:53	bemet01	original 2001 met data
692088	Oct 19	09:27	bemet01.new	2001 met data from pnpswd
696171	Oct 4	09:53	bemet96	original 1996 met data
693984	Oct 19	09:26	bemet96.new	1996 met data from pnpswd
692089	Oct 4	09:54	bemet97	original 1997 met data
692088	Oct 19	09:27	bemet97.new	1997 met data from pnpswd
692089	Oct 4	09:54	bemet98	original 1998 met data
692088	Oct 19	09:27	bemet98.new	1998 met data from pnpswd
692088	Oct 4	09:54	bemet99	original 1999 met data
692088	Oct 19	09:27	bemet99.new	1999 met data from pnpswd
4518	Oct 4	16:01	pnpswd.f	source code for pnpswd
548	Oct 7	11:25	1996.at	ambient temperature flags for 1996
427	Oct 7	11:25	1996.dr	data recovery for 1996
16654	Oct 7	11:25	1996.dt	delta-temperature flags for 1996
839828	Oct 7	11:25	1996.wd	wind direction flags for 1996 (not used)
145	Oct 7	11:25	1996.ws	wind speed flags for 1996
398	Oct 7	11:25	1997.at	ambient temperature flags for 1997
427	Oct 7	11:25	1997.dr	data recovery for 1997
6010	Oct 7	11:25	1997.dt	delta-temperature flags for 1997
80603	Oct 7	11:25	1997.wd	wind direction flags for 1997 (not used)
99	Oct 7	11:25	1997.ws	wind speed flags for 1997
1148	Oct 7	11:25	1998.at	ambient temperature flags for 1998
427	Oct 7	11:25	1998.dr	data recovery for 1998
5242	Oct 7	11:25	1998.dt	delta-temperature flags for 1998
126077	Oct 7	11:25	1998.wd	wind direction flags for 1998 (not used)
53	Oct 7	11:25	1998.ws	wind speed flags for 1998
748	Oct 7	11:24	1999.at	ambient temperature flags for 1999
427	Oct 7	11:24	1999.dr	data recovery for 1999
16486	Oct 7	11:24	1999.dt	delta-temperature flags for 1999
164502	Oct 7	11:24	1999.wd	wind direction flags for 1999 (not used)
99	Oct 7	11:24	1999.ws	wind speed flags for 1999
548	Oct 7	11:24	2000.at	ambient temperature flags for 2000
427	Oct 7	11:24	2000.dr	data recovery for 2000
16778	Oct 7	11:24	2000.dt	delta-temperature flags for 2000
72812	Oct 7	11:24	2000.wd	wind direction flags for 2000 (not used)
53	Oct 7	11:24	2000.ws	wind speed flags for 2000
348	Oct 5	15:49	2001.at	ambient temperature flags for 2001
427	Oct 5	15:49	2001.dr	data recovery for 2001
8254	Oct 5	15:49	2001.dt	delta-temperature flags for 2001
115212	Oct 5	15:49	2001.wd	wind direction flags for 2001 (not used)
99	Oct 5	15:49	2001.ws	wind speed flags for 2001
12142	Oct 5	14:50	becheck.f	source code for becheck
101	Oct 7	11:24	movem	unix script file used to rename becheck output files
497	Oct 20	09:34	beinl9600.m3	metrose 33' input file for 1996-2000 data
501	Oct 4	15:44	beinl9601.m3	metrose 33' input file for 1996-2001 data
496	Oct 20	09:34	beinu9600.m3	metrose 220' input file for 1996-2000 data
501	Oct 4	15:45	beinu9601.m3	metrose 220' input file for 1996-2001 data
85036	Oct 20	09:38	bell9600.out	metrose 33' output file for 1996-2000 data
95256	Oct 19	09:39	bell9601.out	metrose 33' output file for 1996-2001 data
85036	Oct 20	09:39	beul9600.out	metrose 220' output file for 1996-2000 data
95256	Oct 19	09:39	beul9601.out	metrose 220' output file for 1996-2001 data
17230	Oct 20	09:38	metrose.xoqdoq.jfd.10680	33' JFD for input to PAVAN
17230	Oct 20	09:39	metrose.xoqdoq.jfd.10693	220' JFD for input to PAVAN

Note: The time stamp for the files on the CD will be one hour less than shown above; this is due to the Windows XP operating system changing the time stamps of all files whenever Daylight Savings Time ends or begins.

ATTACHMENT C: COMPUTER CODE PNPSWD LISTING

```
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Ver: B.10.20                                pnpswd.f                 Page     1

      program pnpswd
c
c  This program reads PNPS meteorological data from the primary tower
c  in it's "old" format (BECo) and assumes that headers have been
c  insert at the beginning of each month that indicate the number
c  of hours of data in the month (i3 format).
c
c  It checks for wind direction values that are > 360 degrees.
c  The data are output with WD values all set to 360 or less in
c  value; this is accomplished by subtracting 360 from any WD
c  value that is > 360.
c
c  Version 1.0
c  Written 10-04-2004
c  T.A. Messier
c  FANP
c
c
c            Variable List
c
c      yr          integer          year
c      mn          integer          month
c      dy          integer          day
c      hr          integer          hour
c      numhrs      integer          number of hours of data in month
c      ival        integer          number of WD values changed
c
c   Variables uwd through delt are real values but written in the data f
ile
c   as if they were integers; therefore, they will be read/written as in
tegers
c      uwd         real             220' wind direction
c                                   (degrees from True North)
c      uws         real             220' wind speed (MPH)
c      lwd         real             33' wind direction (degrees from Tru
e North)
c      lws         real             33' wind speed (MPH)
c      temp        real             ambient air temperature (degrees F)
c      delt        real             delta temperature (degrees F/187')
c
c      infile      character        input file name
c      outfil      character        output file name
c      banner      character        banner output; date of run, input fi
le name,
c                                   number of WD values changed
c      today       character        date of run
c

      integer yr,mn,dy,hr,numhrs,ival
      integer uwd,uws,lwd,lws,temp,delt
      character*15 infile,outfil,banner
      character*9 today

```

```
      data outfil/'pnpswd.out'/
      data banner/'pnpswd.banner'/
      data ival/0/

c  Ask for input file name
      print *," Enter input file name "
      read(*,2)infile
2     format(a15)

c  Open input file
      open(25,file=infile)

c  Open output file
      open(26,file=outfil)

c  Open banner file
      open(36,file=banner)

c  Get date of run
      call date(today)

c Write code info to banner file
      write(36,3)today
3     format(' FANP Computer Code pnpswd version 1.0',/,/,'  Date of Run:
     &  ',a10,/,/)

c Write input file name to banner file
      write(36,4)infile
4     format(/,'  Input file name:  ',a15,/,/)

c  Read number of hours of hourly data in the month
c  Upon reaching end of all months of data, goto 100
6     read(25,7,end=100)numhrs
7     format(i3)

c  Output numhrs
      write(26,7)numhrs

c  Loop through month of hourly data
      do 20 i=1,numhrs

        read(25,9)yr,mn,dy,hr,uwd,uws,lwd,lws,temp,delt
9       format(4(i2,1x),t50,i4,t55,i4,t60,i4,t65,i4,t70,i4,t75
     &         ,i4)

c  Check if wd is greater than 360 degrees; if so, subtract 360
c  Increment ival when WD values are changed
        if((uwd.gt.360).and.(uwd.lt.541))then
          uwd=uwd-360
          ival=ival+1
        else
        endif
        if((lwd.gt.360).and.(lwd.lt.541))then
```

```
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              lwd=lwd-360
              ival=ival+1
            else
            endif

c  Output the hourly data
            write(26,15)yr,mn,dy,hr,uwd,uws,lwd,lws,temp,delt
15          format(4(i2.2,1x),t50,i4,t55,i4,t60,i4,t65,i4,t70,i4,t75,i4)

20        continue

c  If still data to read, then goto line 6
          goto 6

100       continue

c  Write number of changed WD values to banner file
          write(36,105)ival
105       format('  Number of WD values changed by program pnpswd is:  ',i6,
         &/)

          stop 'PNPS met data written to file named pnpswd.out'
          end

Compilation statistics for procedure: pnpswd

Number of errors:        0        Number of Warnings:     0
Procedure number:     1

Accumulated number of source lines read:    125
```

```
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CROSS REFERENCE LISTING:

Symbol       File            Function       Line

banner          pnpswd.f         pnpswd              *47  51   66
date            pnpswd.f         pnpswd               69
delt            pnpswd.f         pnpswd              *46  91   109
dy              pnpswd.f         pnpswd              *45  91   109
hr              pnpswd.f         pnpswd              *45  91   109
i               pnpswd.f         pnpswd               89
infile          pnpswd.f         pnpswd              *47  56   60   77
ival            pnpswd.f         pnpswd              *45  52   99   104  120
lwd             pnpswd.f         pnpswd              *46  91   102  103  109
lws             pnpswd.f         pnpswd              *46  91   109
mn              pnpswd.f         pnpswd              *45  91   109
numhrs          pnpswd.f         pnpswd              *45  82   86   89
outfil          pnpswd.f         pnpswd              *47  50   63
pnpswd()        pnpswd.f         pnpswd              *1
temp            pnpswd.f         pnpswd              *46  91   109
today           pnpswd.f         pnpswd              *48  69   72
uwd             pnpswd.f         pnpswd              *46  91   97   98   109
uws             pnpswd.f         pnpswd              *46  91   109
yr              pnpswd.f         pnpswd              *45  91   109

SYMBOL TABLE LISTING:

Symbol       Class                Type         Offset/Size

banner          Variable               Character       Data: DS$pnpswd+0
date()          Procedure: intrinsic   Subroutine      ----
delt            Variable               Integer*4       Local: SP -144
dy              Variable               Integer*4       Local: SP -172
hr              Variable               Integer*4       Local: SP -168
i               Variable               Integer*4       Local: SP -188
infile          Variable               Character       Local: SP -344
ival            Variable               Integer*4       Data: SD$pnpswd+0
lwd             Variable               Integer*4       Local: SP -156
lws             Variable               Integer*4       Local: SP -152
mn              Variable               Integer*4       Local: SP -176
numhrs          Variable               Integer*4       Local: SP -192
outfil          Variable               Character       Data: DS$pnpswd+16
pnpswd()        Procedure: this func.  Subroutine
temp            Variable               Integer*4       Local: SP -148
today           Variable               Character       Local: SP -204
uwd             Variable               Integer*4       Local: SP -164
uws             Variable               Integer*4       Local: SP -160
yr              Variable               Integer*4       Local: SP -180

Label  Asm. Label    Type          Line Number(s)

2      L11           Format           57*   56
3      L12           Format           73*   72
4      L13           Format           78*   77
6      L14           Executable       82*   115
7      L15           Format           83*   82   86
9      L17           Format           92*   91
15     L18           Format           110*   109
20     L16           Executable       112*   89
100    L19           Executable       117*   82
105    L20           Format           121*   120
```

```
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Final Compilation Statistics for file: pnpswd.f

Accumulated errors:      0        Number of Warnings:     0
Total number of procedures:      1

Accumulated number of source lines read:      125


Timing Statistics for:

f77pass1:     real:    0.16s    user:    0.00s     sys:    0.00s
```

ATTACHMENT D: COMPUTER CODE BECHECK LISTING

```
      PROGRAM BECHECK

C  THIS PROGRAM READS BECO METEOROLOGICAL DATA IN THEIR FORMAT AND CHECKS
C  FOR SUSPECT DATA.
C  THE PROGRAM PROMPTS THE USER FOR THE NAME OF THE INPUT FILE.
C  THE PROGRAM OUTPUTS FILES CONTAINING SUSPECT DATA DATES AND TIMES FOR
C  THE USER TO THEN USE AS A GUIDE.
C  THE PROGRAM WAS DESIGNED TO BE USED ON UP TO ONE YEAR OF MET. DATA.
C
C  CORRECTED MINOR BUG IN LL WS STUCK SENSOR CHECK; WAS PRINTING
C  BACKUP LL WS INSTEAD OF PRIMARY LL WS ON PRIMARY CHECK

C
C         (NIGHT = HOURS 20 - 3; DAY = HOURS 8 - 16)
C
      CHARACTER*12 INFILE,OUTFIL1,OUTFIL2,OUTFIL3,OUTFIL4
      CHARACTER*12 OUTFIL5,OUTFIL6,OUTFIL7,OUTFIL8,outfil9
      INTEGER YEAR(9000),MONTH(9000),DAY(9000),HOUR(9000),J
      REAL WD160(9000),WS160(9000),WD33B(9000),WS33B(9000),T33B(9000)
      REAL DELTATB(9000)
      REAL WD220(9000),WS220(9000),WD33P(9000),WS33P(9000),T33P(9000)
      REAL DELTATP(9000)

C  ASK USER FOR THE INPUT FILE NAME
      WRITE (*,*) '  ENTER THE NAME OF THE INPUT FILE (IN BECO FORMAT)'
      READ (*,1) INFILE
1     FORMAT(A12)

C  NAME THE OUTPUT FILES
      OUTFIL1='BECHECK.DTB'
      OUTFIL2='BECHECK.DTP'
      OUTFIL3='BECHECK.TB'
      OUTFIL4='BECHECK.TP'
      OUTFIL5='BECHECK.SB'
      OUTFIL6='BECHECK.SP'
      OUTFIL7='BECHECK.WD'
C      OUTFIL7='BECHECK.DB'
C      OUTFIL8='BECHECK.DP'
      OUTFIL9='BECHECK.dr'

C  OPEN THE INPUT FILE
      OPEN(15,FILE=INFILE)

C  OPEN THE OUTPUT FILES
      OPEN(16,FILE=OUTFIL1)
      WRITE(16,2)
2     FORMAT('          BECO BACKUP TOWER SUSPECT DELTA-T DATA')
      OPEN(17,FILE=OUTFIL2)
      WRITE(17,3)
3     FORMAT('          BECO PRIMARY TOWER SUSPECT DELTA-T DATA')
      OPEN(18,FILE=OUTFIL3)
      WRITE(18,4)
4     FORMAT('          BECO BACKUP TOWER SUSPECT TEMP. DATA')
      OPEN(19,FILE=OUTFIL4)
```

```
      WRITE(19,5)
5     FORMAT('           BECO PRIMARY TOWER SUSPECT TEMP. DATA')
      OPEN(20,FILE=OUTFIL5)
      WRITE(20,6)
6     FORMAT('           BECO BACKUP TOWER SUSPECT WIND SPEED DATA')
      OPEN(21,FILE=OUTFIL6)
      WRITE(21,7)
7     FORMAT('           BECO PRIMARY TOWER SUSPECT WIND SPEED DATA')
      OPEN(22,FILE=OUTFIL7)
      WRITE(22,8)
8     FORMAT('           BECO SUSPECT WIND DIRECTION DATA')
C      OPEN(22,FILE=OUTFIL7)
C      WRITE(22,8)
C8     FORMAT('           BECO BACKUP TOWER SUSPECT WIND DIRECTION DATA')
C      OPEN(23,FILE=OUTFIL8)
C      WRITE(23,9)
C9     FORMAT('           BECO PRIMARY TOWER SUSPECT WIND DIRECTION DATA')
      OPEN(24,FILE=OUTFIL9)
      WRITE(24,10)
10    FORMAT('           BECO DATA RECOVERY RATES')

C  WRITE OUTPUT FILE TITLE
C      WRITE(16,*)
C      WRITE(16,12) EXT,YR
C12    FORMAT(24X,'BECO METEOROLOGICAL DATA FOR ',A3,', 19',A2)
C      WRITE(16,*)
C      WRITE(16,*)'             BACKUP TOWER
C     &   PRIMARY TOWER '

C  WRITE DATA HEADERS - DESCRIPTIVE TEXT
C      WRITE(16,13)
C13    FORMAT('YR MN DY HR  WD160 WS160 WD33 WS33 T33 DELTL    WD220 WS22
C     *0 WD33 WS33 T33 DELTU')
C      WRITE(16,*)

C  ZERO OUT DATA ARRAYS
      DO 14 I=1,9000
        YEAR(I)=0
        MONTH(I)=0
        DAY(I)=0
        HOUR(I)=0
        WD160(I)=0.0
        WS160(I)=0.0
        WD33B(I)=0.0
        WS33B(I)=0.0
        T33B(I)=0.0
        DELTATB(I)=0.0
        WD220(I)=0.0
        WS220(I)=0.0
        WD33P(I)=0.0
        WS33P(I)=0.0
        T33P(I)=0.0
        DELTATP(I)=0.0
14    CONTINUE
      inumup=0
      inumdn=0
```

```
C  READ THE METEOROLOGICAL DATA; WHEN REACH END OF FILE, GOTO 30
      J=1
15    READ(15,20,END=30) YEAR(J),MONTH(J),DAY(J),HOUR(J),WD160(J),
     &WS160(J),WD33B(J),WS33B(J),T33B(J),DELTATB(J),WD220(J),WS220(J),
     &WD33P(J),WS33P(J),T33P(J),DELTATP(J)
20    FORMAT(4(I2,1X),T15,F5.0,T20,F5.1,T25,F5.0,T30,F5.1,T35,F5.0,T40,F
     &5.1,T50,F5.0,T55,F5.1,T60,F5.0,T65,F5.1,T70,F5.0,T75,F5.1)
      IF((WD220(j).lt.999.).and.(WS220(j).lt.99.9).and.(deltatp(j).lt.
     &99.9)) inumup=inumup+1
      IF((WD33P(j).lt.999.).and.(WS33P(j).lt.99.9).and.(deltatp(j).lt.
     &99.9)) inumdn=inumdn+1
      J=J+1
      GOTO 15

30    CONTINUE
C  ILASTHR IS LAST HOUR HAVING DATA BEFORE EOF WAS ENCOUNTERED
      ILASTHR=J-1

      ptdn=float(inumdn)/float(ilasthr)*100.
      ptup=float(inumup)/float(ilasthr)*100.
      write(24,*)''
      write(24,*)' BECo meteorological data recovery for the period'
      write(24,22)month(1),day(1),year(1),month(ilasthr),day(ilasthr),
     &year(ilasthr)
22    format(15x,i2,'/',i2,'/',i2,' to ',i2,'/',i2,'/',i2,'.')
      write(24,*)''
      write(24,23)ptdn
23    format(' Primary tower lower level composite data recovery is:
     &  ',f6.2,'%')
      write(24,*)''
      write(24,24)ptup
24    format(' Primary tower upper level composite data recovery is:
     &  ',f6.2,'%')
      write(24,*)''
      write(24,*)' (Note that the composite recovery reported is the per
     &cent of time'
      write(24,*)' that wind speed, wind direction, and delta temperatur
     &e were '
      write(24,*)' available simultaneously.)'

C  LOOK FOR SUSPECT DELTA-T VALUES
      DO 40 I=1,ILASTHR
      IF((DELTATB(I).GT.90.).OR.(DELTATP(I).GT.90.))GOTO 40
C  LOOK FOR UNSTABLE CONDITIONS AT NIGHT (HOURS 20 - 3)
        IF((HOUR(I).GE.20).OR.(HOUR(I).LE.3))THEN

          IF(DELTATB(I).LE.-1.1)WRITE(16,31)YEAR(I),MONTH(I),DAY(I),HOUR
     &    (I),DELTATB(I)

          IF(DELTATP(I).LE.-1.6)WRITE(17,31)YEAR(I),MONTH(I),DAY(I),HOUR
     &    (I),DELTATP(I)

31        FORMAT(/,4(I2,1X),F5.1,' UNSTABLE VALUE AT NIGHT ')
C  LOOK FOR VERY UNSTABLE CONDITIONS DURING THE DAY (HOURS 8 - 16)
        ELSEIF((HOUR(I).GE.8).AND.(HOUR(I).LE.16))THEN

          IF(DELTATB(I).LE.-2.0)WRITE(16,32)YEAR(I),MONTH(I),DAY(I),HOUR
```

```
     &    (I),DELTATB(I)

          IF(DELTATP(I).LE.-3.0)WRITE(17,32)YEAR(I),MONTH(I),DAY(I),HOUR
     &    (I),DELTATP(I)

32        FORMAT(/,4(I2,1X),F5.1,' VERY UNSTABLE VALUE ')
        ELSE
        ENDIF
40    CONTINUE

C  LOOK FOR DAYS THAT HAVE STABLE CONDITIONS EVERY HOUR
      IB=0
      IP=0
      DO 50 I=24,ILASTHR,24
        IF(DELTATB(I).GT.90.)GOTO 45
        IF(DELTATB(I).GE.-0.34)IB=IB+1
        IF(DELTATB(I-1).GE.-0.34)IB=IB+1
        IF(DELTATB(I-2).GE.-0.34)IB=IB+1
        IF(DELTATB(I-3).GE.-0.34)IB=IB+1
        IF(DELTATB(I-4).GE.-0.34)IB=IB+1
        IF(DELTATB(I-5).GE.-0.34)IB=IB+1
        IF(DELTATB(I-6).GE.-0.34)IB=IB+1
        IF(DELTATB(I-7).GE.-0.34)IB=IB+1
        IF(DELTATB(I-8).GE.-0.34)IB=IB+1
        IF(DELTATB(I-9).GE.-0.34)IB=IB+1
        IF(DELTATB(I-10).GE.-0.34)IB=IB+1
        IF(DELTATB(I-11).GE.-0.34)IB=IB+1
        IF(DELTATB(I-12).GE.-0.34)IB=IB+1
        IF(DELTATB(I-13).GE.-0.34)IB=IB+1
        IF(DELTATB(I-14).GE.-0.34)IB=IB+1
        IF(DELTATB(I-15).GE.-0.34)IB=IB+1
        IF(DELTATB(I-16).GE.-0.34)IB=IB+1
        IF(DELTATB(I-17).GE.-0.34)IB=IB+1
        IF(DELTATB(I-18).GE.-0.34)IB=IB+1
        IF(DELTATB(I-19).GE.-0.34)IB=IB+1
        IF(DELTATB(I-20).GE.-0.34)IB=IB+1
        IF(DELTATB(I-21).GE.-0.34)IB=IB+1
        IF(DELTATB(I-22).GE.-0.34)IB=IB+1
        IF(DELTATB(I-23).GE.-0.34)IB=IB+1
          IF(IB.EQ.24)THEN
            WRITE(16,42)YEAR(I),MONTH(I),DAY(I)
42          FORMAT(/,1X,3(I2,1X),' STABLE ALL DAY ')
          ELSE
            IB=0
          ENDIF
45      IF(DELTATP(I).GT.90.)GOTO 50
        IF(DELTATP(I).GE.-0.5)IP=IP+1
        IF(DELTATP(I-1).GE.-0.5)IP=IP+1
        IF(DELTATP(I-2).GE.-0.5)IP=IP+1
        IF(DELTATP(I-3).GE.-0.5)IP=IP+1
        IF(DELTATP(I-4).GE.-0.5)IP=IP+1
        IF(DELTATP(I-5).GE.-0.5)IP=IP+1
        IF(DELTATP(I-6).GE.-0.5)IP=IP+1
        IF(DELTATP(I-7).GE.-0.5)IP=IP+1
        IF(DELTATP(I-8).GE.-0.5)IP=IP+1
        IF(DELTATP(I-9).GE.-0.5)IP=IP+1
        IF(DELTATP(I-10).GE.-0.5)IP=IP+1
```

```
          IF(DELTATP(I-11).GE.-0.5)IP=IP+1
          IF(DELTATP(I-12).GE.-0.5)IP=IP+1
          IF(DELTATP(I-13).GE.-0.5)IP=IP+1
          IF(DELTATP(I-14).GE.-0.5)IP=IP+1
          IF(DELTATP(I-15).GE.-0.5)IP=IP+1
          IF(DELTATP(I-16).GE.-0.5)IP=IP+1
          IF(DELTATP(I-17).GE.-0.5)IP=IP+1
          IF(DELTATP(I-18).GE.-0.5)IP=IP+1
          IF(DELTATP(I-19).GE.-0.5)IP=IP+1
          IF(DELTATP(I-20).GE.-0.5)IP=IP+1
          IF(DELTATP(I-21).GE.-0.5)IP=IP+1
          IF(DELTATP(I-22).GE.-0.5)IP=IP+1
          IF(DELTATP(I-23).GE.-0.5)IP=IP+1
            IF(IP.EQ.24)THEN
              WRITE(17,42)YEAR(I),MONTH(I),DAY(I)
            ELSE
              IP=0
            ENDIF
50      CONTINUE

C   LOOK FOR SUSPECT TEMPERATURE DATA (1 HR CHANGE OF > 10 DEG F)
        IEND=ILASTHR-1
        DO 60 I=1,IEND
        IF((T33B(I).GT.99.).OR.(T33B(I+1).GT.99.))GOTO 53
C   BACKUP TOWER LOWER LEVEL TEMPERATURE
          TTB1=T33B(I)+10.0
          TTB2=T33B(I)-10.0
          IF((T33B(I+1).GE.TTB1).OR.(T33B(I+1).LE.TTB2))THEN
            WRITE(18,52)YEAR(I+1),MONTH(I+1),DAY(I+1),HOUR(I+1),T33B(I+1)
52          FORMAT(/,1X,4(I2,1X),F5.0,' TEMP. CHANGE > 10 DEG F !!!!!')
          ELSE
          ENDIF
53        IF((T33P(I).GT.99.).OR.(T33P(I+1).GT.99.))GOTO 60
C   PRIMARY TOWER LOWER LEVEL TEMPERATURE
          TTP1=T33P(I)+10.0
          TTP2=T33P(I)-10.0
          IF((T33P(I+1).GE.TTP1).OR.(T33P(I+1).LE.TTP2))THEN
            WRITE(19,52)YEAR(I+1),MONTH(I+1),DAY(I+1),HOUR(I+1),T33P(I+1)
          ELSE
          ENDIF
60      CONTINUE

C   CHECK FOR SUSPECT WIND SPEED DATA - LOOK FOR STUCK WS SENSOR:
C   IF WS IS SAME FOR A FOUR HOUR PERIOD, ASSUME SENSOR IS STUCK
        DO 70 I=4,ILASTHR,4
        IF(WS33B(I).GT.999.)GOTO 64
          IF((WS33B(I).EQ.WS33B(I-1)).AND.(WS33B(I).EQ.WS33B(I-2)).AND.(WS
     &   33B(I).EQ.WS33B(I-3)))THEN
            WRITE(20,65)YEAR(I),MONTH(I),DAY(I),HOUR(I),WS33B(I)
65          FORMAT(/,1X,4(I2,1X),F5.1,' LL WS SENSOR MAY BE STUCK')
          ELSE
          ENDIF
64      IF(WS160(I).GT.999.)GOTO 63
          IF((WS160(I).EQ.WS160(I-1)).AND.(WS160(I).EQ.WS160(I-2)).AND
     &   .(WS160(I).EQ.WS160(I-3)))THEN
            WRITE(20,66)YEAR(I),MONTH(I),DAY(I),HOUR(I),WS160(I)
66          FORMAT(/,1X,4(I2,1X),F5.1,' UL WS SENSOR MAY BE STUCK')
```

```
       ELSE
       ENDIF
63    IF(WS33P(I).GT.999.)GOTO 62
       IF((WS33P(I).EQ.WS33P(I-1)).AND.(WS33P(I).EQ.WS33P(I-2)).AND.(WS
     & 33P(I).EQ.WS33P(I-3)))THEN
        WRITE(21,65)YEAR(I),MONTH(I),DAY(I),HOUR(I),WS33P(I)
       ELSE
       ENDIF
62     IF(WS220(I).GT.999.)GOTO 70
       IF((WS220(I).EQ.WS220(I-1)).AND.(WS220(I).EQ.WS220(I-2)).AND
     & .(WS220(I).EQ.WS220(I-3)))THEN
        WRITE(21,66)YEAR(I),MONTH(I),DAY(I),HOUR(I),WS220(I)
       ELSE
       ENDIF
70     CONTINUE
C
C  CHECK FOR SUSPECT WIND DIRECTION DATA - COMPARE THE TWO TOWERS; IF WITHIN
C  22 DEG OF ONE ANOTHER ASSUME THEY ARE OKAY; OTHERWISE, ASSUME THERE IS A
C  PROBLEM WITH ONE OF THE TOWERS
C  IF ONE WD VALUE IS BETWEEN 270 AND 360 AND THE OTHER IS BETWEEN 0 AND 90,
C  THEN ADD 360 TO THE VALUE BETWEEN 0 AND 90 BEFORE TESTING.
C
      IUWD=0
      DO 80 I=1,ILASTHR
       IF((WD220(I).GT.900.).OR.(WD160(I).GT.900.))GOTO 80
       IF((WD220(I).GE.270.).AND.(WD220(I).LE.360.).AND.(WD160(I).GE.
     & 0.0).AND.(WD160(I).LE.90))WD160(I)=WD160(I)+360.
       IF((WD160(I).GE.270.).AND.(WD160(I).LE.360.).AND.(WD220(I).GE.
     & 0.0).AND.(WD220(I).LE.90))WD220(I)=WD220(I)+360.
       PUP=WD220(I)+22.
       PUM=WD220(I)-22.
       IF((WD160(I).GE.PUM).AND.(WD160(I).LE.PUP))THEN
        IUWD=IUWD+1
       ELSE
        WRITE(22,75)YEAR(I),MONTH(I),DAY(I),HOUR(I)
75      FORMAT(/,1X,4(I2,1X),'  UL WD VALUES > 22 DEG APART    UL WD')
       ENDIF
80    CONTINUE
      ILWD=0
      DO 90 I=1,ILASTHR
       IF((WD33P(I).GT.900.).OR.(WD33B(I).GT.900.))GOTO 90
       IF((WD33P(I).GE.270.).AND.(WD33P(I).LE.360.).AND.(WD33B(I).GE.
     & 0.0).AND.(WD33B(I).LE.90))WD33B(I)=WD33B(I)+360.
       IF((WD33B(I).GE.270.).AND.(WD33B(I).LE.360.).AND.(WD33P(I).GE.
     & 0.0).AND.(WD33P(I).LE.90))WD33P(I)=WD33P(I)+360.
       PLP=WD33P(I)+22.
       PLM=WD33P(I)-22.
       IF((WD33B(I).GE.PLM).AND.(WD33B(I).LE.PLP))THEN
        ILWD=ILWD+1
       ELSE
        WRITE(22,85)YEAR(I),MONTH(I),DAY(I),HOUR(I)
85      FORMAT(/,1X,4(I2,1X),'  LL WD VALUES > 22 DEG APART    LL WD')
       ENDIF
90    CONTINUE

100   CLOSE(15)
```

```
      CLOSE(16)
      CLOSE(17)
      CLOSE(18)
      CLOSE(19)
      CLOSE(20)
      CLOSE(21)
      CLOSE(22)
      CLOSE(24)

      STOP
      END
```

20032-33 (6/23/2004)

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N/A	32-5052125-00	Conversion of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data for Use With ARCON96	S	N	Y	N

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CALCULATION SUMMARY SHEET (CSS)

Document Identifier 32-5052125-00

Title Conversion of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data for Use With ARCON96

PREPARED BY:	REVIEWED BY:
	METHOD: ☒ DETAILED CHECK ☐ INDEPENDENT CALCULATION
NAME Theodore A. Messier	NAME John N. Hamawi
SIGNATURE Theodore A. Messier	SIGNATURE John Hamawi 11/3/04
TITLE Meteorologist DATE 10-20-04	TITLE Consulting Radiological Eng. DATE
COST CENTER 41758 REF. PAGE(S) 7	TM STATEMENT: REVIEWER INDEPENDENCE

PURPOSE AND SUMMARY OF RESULTS:

Purpose

Convert meteorological data recorded by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station from January 1996 through December 2001 into a format suitable for use with computer code ARCON96.

Results

Meteorological data recorded on the 220' primary tower by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station from January 1996 through December 2001 were converted into a format suitable for use with computer code ARCON96.

This calculation is safety related and was prepared under the AREVA/Framatome ANP Quality Assurance Program.

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:		THE DOCUMENT CONTAINS ASSUMPTIONS THAT MUST BE VERIFIED PRIOR TO USE ON SAFETY-RELATED WORK
CODE/VERSION/REV	CODE/VERSION/REV	
		☐ YES ☒ NO

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DESIGN VERIFICATION CHECKLIST

Document Identifier 32-5052125-00 - Page 2 of 16

Title Conversion of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data for Use With ARCON96

1.	Were the inputs correctly selected and incorporated into design or analysis?	☑ Y	☐ N	☐ N/A
2.	Are assumptions necessary to perform the design or analysis activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent re-verifications when the detailed design activities are completed?	☑ Y	☐ N	☐ N/A
3.	Are the appropriate quality and quality assurance requirements specified? Or, for documents prepared per FANP procedures, have the procedural requirements been met?	☑ Y	☐ N	☐ N/A
4.	If the design or analysis cites or is required to cite requirements or criteria based upon applicable codes, standards, specific regulatory requirements, including issue and addenda, are these properly identified, and are the requirements/criteria for design or analysis met?	~~☑~~ Y 11/3/04	☐ N	☑ N/A
5.	Have applicable construction and operating experience been considered?	☐ Y	☐ N	☑ N/A
6.	Have the design interface requirements been satisfied?	☐ Y	☐ N	☑ N/A
7.	Was an appropriate design or analytical method used?	☑ Y	☐ N	☐ N/A
8.	Is the output reasonable compared to inputs?	☑ Y	☐ N	☐ N/A
9.	Are the specified parts, equipment and processes suitable for the required application?	☐ Y	☐ N	☑ N/A
10.	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?	☐ Y	☐ N	☑ N/A
11.	Have adequate maintenance features and requirements been specified?	☐ Y	☐ N	☑ N/A
12.	Are accessibility and other design provisions adequate for performance of needed maintenance and repair?	☐ Y	☐ N	☑ N/A
13.	Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?	☐ Y	☐ N	☑ N/A
14.	Has the design properly considered radiation exposure to the public and plant personnel?	☐ Y	☐ N	☑ N/A
15.	Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?	☐ Y	☐ N	☑ N/A
16.	Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?	☐ Y	☐ N	☑ N/A
17.	Are adequate handling, storage, cleaning and shipping requirements specified?	☐ Y	☐ N	☑ N/A
18.	Are adequate identification requirements specified?	☐ Y	☐ N	☑ N/A
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DESIGN VERIFICATION CHECKLIST

Document Identifier: 32-5052125-00 - Page 3 of 16

Comments:

Verified By:	John N. Hamawi	John Hamawi	11/3/04
(First, MI, Last)	Printed / Typed Name	Signature	Date

RECORD OF REVISIONS

Place holder for future revisions, if any.

TABLE OF CONTENTS

1.0 Purpose/Objective

Convert meteorological data recorded by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station (PNPS) from January 1996 through December 2001 into a format suitable for use with computer code ARCON96 as requested in Entergy/Pilgrim Contract Order Number 4500534887 (Reference 1).

2.0 Assumptions and Key Assumptions

Since the base of the backup meteorological tower is not located on a natural surface, it was assumed that the data from that tower were not suitable for use in this calculation.

A key assumption is any assumption or limitation that must be verified prior to using the results and/or conclusions of a calculation for a safety-related task. There are no key assumptions in the present calculation.

3.0 Computing Environment

The computer runs in this calculation involved the use of computer code reform and were carried out on the HP 9000/785 CPU running the HP UX B.10.20 operating system. Computer code reform was written expressly for use in this calculation and its usage is validated in Attachment A.

4.0 Quality Assurance

This work was performed under Framatome's Quality Assurance Program, and Framatome Procedure 0402-01 (Preparing and Processing FANP Calculations) was followed.

5.0 Calculations

Meteorological data recorded by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station from January 1996 through December 2001 were evaluated in Reference 2 and determined to be suitable for use in atmospheric dispersion analyses. The temperature sensor separation was obtained from Reference 4.

Computer code reform was developed specifically for this calculation to reformat the 1996-2001 PNPS meteorological data from its standard format to the format required by the ARCON96 computer code. A listing of this code is provided in Attachment A. The source code file name is reform.f and the executable file name is reform.e. The file sizes in bytes and the creation date/time are:

```
permissions   file owner    group      size in bytes  date/time      file name
-rwxrwxrwx    1 messier     eed             41060 Oct 19 09:34 reform.e
-rw-r-----    1 messier     eed              5398 Oct 19 09:34 reform.f
```

Each of the six annual meteorological files were input to reform and two files were output in each of the six runs: the so-called banner file which lists the computer code name, version number, input/output file names, and run date; the main output file of meteorological data converted for use with compute code ARCON96.

The input meteorological data (see Exhibit 1 for format), the reformatted meteorological data (see Reference 3 for format), and the source code for the reform computer code have been stored on the FANP COLD server for archival storage and written to a compact disc for PNPS. A listing of the file names is provided in Attachment B.

Testing and validation of the reform computer code is documented in Attachment C. The reform computer code was run on an HP UNIX Workstation 9000/785 under the HP-UX UNIX B.10.20 operating system.

6.0 Results/Conclusion

Meteorological data recorded on the 220' primary tower by the onsite meteorological monitoring system at Pilgrim Nuclear Power Station from January 1996 through December 2001 were converted into a format suitable for use with computer code ARCON96.

7.0 References

1. Entergy/Pilgrim Contract Order Number 4500534887.
2. FANP Calculation 32-5052036-00, "Evaluation of Pilgrim Nuclear Power Station 1996-2001 Meteorological Data", dated October 2004.
3. U.S. Nuclear Regulatory Commission Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants", June 2003.
4. AREVA/FANP Calculation BEC-018, Revision 1, "Meteorological Inputs to the AEOLUS-2 Program for Pilgrim Station", dated 10/23/91.

Exhibit 1: Input Meteorological Data Format

Parameter (units)	# of Chars.	Columns
Year	2	01-02
Month	2	04-05
Day	2	07-08
Hour	2	10-11
160 Foot Tower: (See note below.)		
Wind Direction; 160 ft (degrees from)	*4*	*15-18*
Wind Speed; 160 ft (tenths of mph)	*4*	*20-23*
Wind Direction; 33 ft (degrees from)	*4*	*25-28*
Wind Speed; 33 ft (tenths of mph)	*4*	*30-33*
Temperature; 33 ft (degrees F)	*4*	*35-38*
Delta T; 160-33 ft (Tenths of degrees F)	*4*	*40-43*
220 Foot Tower:		
Wind Direction; 220 ft (degrees from)	4	50-53
Wind Speed; 220 ft (tenths of mph)	4	55-58
Wind Direction; 33 ft (degrees from)	4	60-63
Wind Speed; 33 ft (tenths of mph)	4	65-68
Temperature; 33 ft (degrees F)	4	70-73
Delta T; 220-33 ft (Tenths of degrees F)	4	75-78

Note: Data from the 160' tower are not in the data files to insure that they are not used. The rest of the data files input to reform were in the format listed above.

ATTACHMENT A: COMPUTER CODE REFORM LISTING

```
HP FORTRAN 77                                   Tue Oct 19 09:34:45 2004
Ver: B.10.20                                    reform.f                 Page     1
```

```
      Program reform
c
c     Version 1.0
c
c     This program reformats PNPS standard meteorological data
c     to the format required by ARCON96.  It asks the user for the
c     input (in old BECo format) and output file names, one at a
c     time.  For each year processed, it asks whether it is a leap year,
c     for use in the date conversion to julian.
c
c     The program assumes that the wind direction values are
c     between 0 and 360 degrees, that the wind speed units are MPH,
c     and that the delta-T units are degrees Fahrenheit.
c
c     FANP
c     Written on 10-05-2004 by T.A. Messier
c
c**********
      character infile*60,outfile*60,leap,ident*5,banner*20
      character*9 today
      real uws,uwd,lws,lwd,temp,delt
c**********
      ident='PNPS '
      banner='reform_banner.txt'
c
c**** Loop through all years of interest
   50 write(*,*) ' Enter the met data input file name for ',
     m 'the year of interest,'
      write(*,*) ' or enter "stop" to end:  '
      read(*,*) infile
      if(infile.eq.'stop') go to 400
      open(15,file=infile,status='old',err=50)
      outfile='pnps'//infile(6:7)//'.met'
      banner='reform_banner.'//infile(6:7)
      open(16,file=outfile,status='new')

      open(26,file=banner)
      write(26,60)
60    format(/,' FANP Program reform version 1.0 ',/,/)

c**   Get the run date
      call date(today)

c
   80 write(*,*) ' Is the selected year a leap year? (Enter y or n):'
      read(*,*) leap
      if(leap.ne.'y'.and.leap.ne.'n') go to 80

c**   Write run info to banner file
      write(26,82)infile,outfile,today,leap
82    format('    Input file name :  ',a60,/,'    Output file name:  ',a
     &60,/,/,'    Run Date        :  ',a9,/,/,'    Leap Year       :  ',
     &a1,/,/)
```

```

c**   Read the met data file
      iseq = 0
  100 iseq = iseq + 1
      read(15,2000,end=300) iyear,imonth,iday,ihour,uwd,uws,lwd,lws,
     m  temp,delt
      if(iday.eq.0) then
        iseq = iseq - 1
        go to 100
      endif
c
c**   Figure out from month and day of year what julian date it is
c
      if(imonth.eq.1) juldate = iday
      if(imonth.eq.2) juldate = iday + 31
      if(leap.eq.'y') then
        if(imonth.eq.3) juldate = iday + 60
        if(imonth.eq.4) juldate = iday + 91
        if(imonth.eq.5) juldate = iday + 121
        if(imonth.eq.6) juldate = iday + 152
        if(imonth.eq.7) juldate = iday + 182
        if(imonth.eq.8) juldate = iday + 213
        if(imonth.eq.9) juldate = iday + 244
        if(imonth.eq.10) juldate = iday + 274
        if(imonth.eq.11) juldate = iday + 305
        if(imonth.eq.12) juldate = iday + 335
      else
        if(imonth.eq.3) juldate = iday + 59
        if(imonth.eq.4) juldate = iday + 90
        if(imonth.eq.5) juldate = iday + 120
        if(imonth.eq.6) juldate = iday + 151
        if(imonth.eq.7) juldate = iday + 181
        if(imonth.eq.8) juldate = iday + 212
        if(imonth.eq.9) juldate = iday + 243
        if(imonth.eq.10) juldate = iday + 273
        if(imonth.eq.11) juldate = iday + 304
        if(imonth.eq.12) juldate = iday + 334
      endif
c**   Check for missing hourly data
      julday2 = (iseq-1)/24 + 1
      if(juldate.ne.julday2) then
        write(*,*)
        write(*,*) ' Missing hourly data encountered.  Check:'
        write(*,*) iyear,iday,imonth,ihour
        write(*,*) ' Analysis terminated!'
        stop
      endif
c
c**   Process wind speed and wind directions for ARCON96
c
c     Lower-level and upper-level wind speeds
      if(lws.lt.99.0) then
        ilws = nint(lws*10.) + 0.01
```

```
      else
        ilws = 9999
      endif
c
      if(uws.lt.99.0) then
        iuws = nint(uws*10.) + 0.01
      else
        iuws = 9999
      endif
c
c     Lower-level and upper-level wind directions
      if(uwd.le.360.0) then
        iuwd = nint(uwd) + 0.01
        iuwd = mod(iuwd,360)
        if(iuwd.lt.1) iuwd = 360
      else
        iuwd = 999
      endif
c
      if(lwd.le.360.0) then
        ilwd = nint(lwd) + 0.01
        ilwd = mod(ilwd,360)
        if(ilwd.lt.1) ilwd = 360
      else
        ilwd = 999
      endif
c
c**   Process delta-T and identify stability class, based on RG 1.23
c     Use delt for ground-level releases, and delt for stack releases
c     since there is only one delta-T observation for PNPS 220' tower
        dt = delt
        dh = (220.0 - 33.0)*0.3048
      if (dt.gt.99.)then
c       data is either bad, or missing
        istab = 99
        goto 200
      else
        dt = dt*(5.0/9.0)*(100.0/dh)
        if(dt.le.-1.9) then
          istab = 1
        elseif((dt.gt.-1.9).and.(dt.le.-1.7)) then
          istab = 2
        elseif((dt.gt.-1.7).and.(dt.le.-1.5)) then
          istab = 3
        elseif((dt.gt.-1.5).and.(dt.le.-0.5)) then
          istab = 4
        elseif((dt.gt.-0.5).and.(dt.le.1.5)) then
          istab = 5
        elseif((dt.gt.1.5).and.(dt.le.4.0)) then
          istab = 6
        elseif(dt.gt.4.0) then
          istab = 7
        else
```

```
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        endif
      endif
  200 write(16,2100) ident,iyear,juldate,ihour,ilwd,ilws,istab,iuwd,iuws

      go to 100

  300 continue

      close (15)
      close (26)

      go to 50

  400 close (16)
      stop 'PNPS meteorological data reformated for ARCON96'
c
c**********
 2000 format(4(i2,1x),t50,f4.0,t55,f4.1,t60,f4.0,t65,f4.1,t70,f4.0,t75,f
     & 4.1)
 2100 format(1x,a5,i2,1x,i3,i2,2x,i3,i4,1x,i2,2x,i3,i4)
      end

Compilation statistics for procedure: reform

Number of errors:       0        Number of Warnings:      0
Procedure number:     1

Accumulated number of source lines read:     180
```

```
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CROSS REFERENCE LISTING:

Symbol        File              Function         Line

banner          reform.f            reform            *19   24   34   37
date            reform.f            reform             42
delt            reform.f            reform            *21   58   137
dh              reform.f            reform             138   144
dt              reform.f            reform             137   139   144   145
                                                       147   149   151   153   155
                                                       157
iday            reform.f            reform             58   60   67   68   70   71
                                                       72   73   74   75   76   77   78
                                                       79   81   82   83   84   85   86
                                                       87   88   89   90   97
ident           reform.f            reform            *19   23   162
ihour           reform.f            reform             58   97   162
ilwd            reform.f            reform             127   128   129   131
                                                       162
ilws            reform.f            reform             106   108   162
imonth          reform.f            reform             58   67   68   70   71   72
                                                       73   74   75   76   77   78   79
                                                       81   82   83   84   85   86   87
                                                       88   89   90   97
infile          reform.f            reform            *19   30   31   32   33   34
                                                       50
iseq            reform.f            reform             56   57   61   93
istab           reform.f            reform             141   146   148   150
                                                       152   154   156   158   162
iuwd            reform.f            reform             119   120   121   123
                                                       162
iuws            reform.f            reform             112   114   162
iyear           reform.f            reform             58   97   162
juldate         reform.f            reform             67   68   70   71   72   73
                                                       74   75   76   77   78   79   81
                                                       82   83   84   85   86   87   88
                                                       89   90   94   162
julday2         reform.f            reform             93   94
leap            reform.f            reform            *19   46   47   50   69
lwd             reform.f            reform            *21   58   126   127
lws             reform.f            reform            *21   58   105   106
mod             reform.f            reform             120   128
nint            reform.f            reform             106   112   119   127
outfile         reform.f            reform            *19   33   35   50
reform()        reform.f            reform            *1
temp            reform.f            reform            *21   58
today           reform.f            reform            *20   42   50
uwd             reform.f            reform            *21   58   118   119
uws             reform.f            reform            *21   58   111   112
```

```
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SYMBOL TABLE LISTING:

Symbol     Class                Type        Offset/Size

banner       Variable                 Character      Local: SP -696
date()       Procedure: intrinsic     Subroutine     ----
delt         Variable                 Real*4         Local: SP -228
dh           Variable                 Real*4         Local: SP -144
dt           Variable                 Real*4         Local: SP -148
iday         Variable                 Integer*4      Local: SP -256
ident        Variable                 Character      Local: SP -704
ihour        Variable                 Integer*4      Local: SP -252
ilwd         Variable                 Integer*4      Local: SP -152
ilws         Variable                 Integer*4      Local: SP -172
imonth       Variable                 Integer*4      Local: SP -260
infile       Variable                 Character      Local: SP -584
iseq         Variable                 Integer*4      Local: SP -268
istab        Variable                 Integer*4      Local: SP -140
iuwd         Variable                 Integer*4      Local: SP -156
iuws         Variable                 Integer*4      Local: SP -160
iyear        Variable                 Integer*4      Local: SP -264
juldate      Variable                 Integer*4      Local: SP -224
julday2      Variable                 Integer*4      Local: SP -220
leap         Variable                 Character      Local: SP -272
lwd          Variable                 Real*4         Local: SP -240
lws          Variable                 Real*4         Local: SP -236
mod()        Procedure: intrinsic     --------       ----
nint()       Procedure: intrinsic     --------       ----
outfile      Variable                 Character      Local: SP -400
reform()     Procedure: this func.    Subroutine
temp         Variable                 Real*4         Local: SP -232
today        Variable                 Character      Local: SP -336
uwd          Variable                 Real*4         Local: SP -248
uws          Variable                 Real*4         Local: SP -244

Label  Asm. Label   Type        Line Number(s)

50     L11          Executable    27*   32  171
60     L13          Format        39*   38
80     L14          Executable    45*   47
82     L15          Format        51*   50
100    L16          Executable    57*   62  164
200    L17          Executable    162*   142
300    L18          Executable    166*   58
400    L12          Executable    173*   31
2000   L19          Format        177*   58
2100   L20          Format        179*   162


Final Compilation Statistics for file: reform.f

Accumulated errors:     0        Number of Warnings:     0
Total number of procedures:     1

Accumulated number of source lines read:    180


Timing Statistics for:

f77pass1:     real:   0.17s   user:   0.00s    sys:   0.00s
```

ATTACHMENT B: COMPUTER INPUT AND OUTPUT FILES

The following computer runs were carried out for this calculation:

reform

1996 PNPS 1996 meteorological data; input file bemet96.new; output files reform_banner.96 and pnps96.met

1997 PNPS 1997 meteorological data; input file bemet97.new; output files reform_banner.97 and pnps 97. met

1998 PNPS 1998 meteorological data; input file bemet98.new; output files reform_banner.98 and pnps 98. met

1999 PNPS 1999 meteorological data; input file bemet99.new; output files reform_banner.99 and pnps 99. met

2000 PNPS 2000 meteorological data; input file bemet00.new; output files reform_banner.00 and pnps 00. met

2001 PNPS 2001 meteorological data; input file bemet01.new; output files reform_banner.01 and pnps 01.met

Listing of Files Included on the Compact Disc and Transferred to the FANP COLD Server for Archival Storage

File Size in Bytes	Date	Time	File Name	File Description
693984	Oct 19	09:27	bemet00.new	input 2000 meteorological data
692088	Oct 19	09:27	bemet01.new	input 2001 meteorological data
693984	Oct 19	09:26	bemet96.new	input 1996 meteorological data
692088	Oct 19	09:27	bemet97.new	input 1997 meteorological data
692088	Oct 19	09:27	bemet98.new	input 1998 meteorological data
692088	Oct 19	09:27	bemet99.new	input 1999 meteorological data
316224	Oct 19	09:35	pnps00.met	output 2000 meteorological data
315360	Oct 19	09:35	pnps01.met	output 2001 meteorological data
316224	Oct 19	09:35	pnps96.met	output 1996 meteorological data
315360	Oct 19	09:35	pnps97.met	output 1997 meteorological data
315360	Oct 19	09:35	pnps98.met	output 1998 meteorological data
315360	Oct 19	09:35	pnps99.met	output 1999 meteorological data
13760	Oct 19	09:34	reform.1	code listing for computer code reform
267	Oct 19	09:35	reform_banner.00	banner output for reform using 2000 data
267	Oct 19	09:35	reform_banner.01	banner output for reform using 2001 data
267	Oct 19	09:35	reform_banner.96	banner output for reform using 1996 data
267	Oct 19	09:35	reform_banner.97	banner output for reform using 1997 data
267	Oct 19	09:35	reform_banner.98	banner output for reform using 1998 data
267	Oct 19	09:35	reform_banner.99	banner output for reform using 1999 data

Note: The time stamp for the files on the CD will be one hour less than shown above; this is due to the Windows XP operating system changing the time stamps of all files whenever Daylight Savings Time ends or begins.

ATTACHMENT C: Validation of Computer Code reform

Computer code reform was written to convert PNPS meteorological data into a format suitable for use with computer code ARCON96.

To test that the code functioned properly, some data were compared from the input and output files:

Input 1996 Meteorological Data

```
YR MN DY HR                                         UWD  UWS  LWD  LWS TEMP   DT
96  3 13 22                                         217   65  219   68   36   70
96  1  1  1                                         310  106  276   40   32   22
96  1  1  2                                         310   88  265   35   33   10
96  1  1 10                                           5  181  353   93   35  -12
96  1  1  9                                         327  126  295   53   36  -16
96  1  6 13                                         292  158  297   80   15  -18
96  1  6 12                                         297  195  305   70   14  -22
96  2 15 10                                        9999 9999 9999 9999 9999 9999
```

Converted 1996 Meteorological Data

```
        YR  JD HR  LWD LWD SC  UWD UWS
 PNPS 96   7322  219  68  7  217  65
 PNPS 96    1 1  276  40  6  310 106
 PNPS 96    1 2  265  35  5  310  88
 PNPS 96    110  353  93  4    5 181
 PNPS 96    1 9  295  53  3  327 126
 PNPS 96    613  297  80  2  292 158
 PNPS 96    612  305  70  1  297 195
 PNPS 96   4610  9999999 99  9999999
```

The data comparison shows that the code correctly converted from year, month, day, hour to Julian Day, hour format. Wind speed and wind direction values were converted correctly. Delta-temperature values were converted correctly to stability class (A=1, B=2, C=3, D=4, E=5, F=6, G=7, bad or missing=99). Wind speed and wind direction values flagged as bad or missing were correctly converted.

Attachment 4 to 2.04.115

Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Plant
Proposed Amendment to the Technical Specifications

Proposed Changes to the
Pilgrim Technical Specifications

Marked-Up and Insert Pages (13 pages)

TS Page 3/4.2-24
TS Page 3/4.7-11
TS Page 3/4.7-12
TS Page 3/4.7-13
TS Page 3/4.7-14
TS Page 3/4.7-15
TS Page 3/4.7-16

TS Bases Pages
B3/4.7-10
B3/4.7-11
B3/4.7-12
Insert A to page B3/4.7-10 and
Insert B to page B3/4.7-12
B3/4.7-13
Inserts C to page B3/4.7-13

PNPS
TABLE 3.2.D

RADIATION MONITORING SYSTEMS THAT INITIATE AND/OR ISOLATE

Minimum # of Operable Instrument Channels Per Trip system (1)	Trip Function	Trip Level Setting	Action (2)
2	Refuel Area Exhaust Monitors	Upscale, <100 mr/hr	A or B
2	Refuel Area Exhaust Monitors	Downscale	A or B

NOTES FOR TABLE 3.2.D

1. Whenever the systems are required to be operable, there shall be two operable or tripped trip systems. If this cannot be met, the indicated action shall be taken.

2. Action

   A. Cease operation of the refueling equipment

   movement of recently irradiated fuel assemblies and operations with potential to drain the reactor vessel (OPDRVs)

   B. Isolate secondary containment and start the standby gas treatment system

   during

LIMITING CONDITIONS FOR OPERATION

3.7 CONTAINMENT SYSTEMS (Cont.)

A. Primary Containment (Cont.)
With no H_2 analyzer operable, reactor operation is allowed for up to 48 hours. If one of the inoperable analyzers is not made fully operable within 48 hours, the reactor shall be in at least Hot Shutdown within the next 12 hours.

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System

1. Standby Gas Treatment System

   a. Except as specified in 3.7.B.1.c or 3.7.B.1.e below, both trains of the standby gas treatment shall be operable when in the Run, Startup, and Hot Shutdown MODES, during movement of recently irradiated fuel assemblies in the secondary containment, and during movement of new fuel over the spent fuel pool, and during CORE ALTERATIONS. and during operations with a potential for draining the reactor vessel (OPDRVs),

   or

   the reactor shall be in cold shutdown within the next 36 hours.

   b. 1. The results of the in-place cold DOP tests on HEPA filters shall show ≥99% DOP removal. The results of halogenated hydrocarbon tests on charcoal adsorber banks shall show ≥99.9% halogenated hydrocarbon removal.

SURVEILLANCE REQUIREMENTS

4.7 CONTAINMENT SYSTEMS (Cont.)

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System

1. Standby Gas Treatment System

   a. 1. At least once per operating cycle, it shall be demonstrated that pressure drop across the combined high efficiency filters and charcoal adsorber banks is less than 8 inches of water at 4000 cfm.

   2. At least once per operating cycle, demonstrate that the inlet heaters on each train are operable and are capable of an output of at least 20 kW.

   3. The tests and analysis of Specification 3.7.B.1.b. shall be performed at least once per operating cycle or following painting, fire or chemical release in any ventilation zone communicating with the system while the system is operating that could contaminate the HEPA filters or charcoal adsorbers.

   4. At least once per operating cycle, automatic initiation of

3.7 CONTAINMENT SYSTEMS (Cont.)

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System (Cont.)

b. 2. The results of the laboratory carbon sample analysis shall show each carbon adsorber bank is capable of ≥97.5% methyl iodide removal at 70% R.H. and 86°F. The carbon sample shall be obtained in accordance with Regulatory Position C.6.b of Regulatory Guide 1.52, Revision 2, March 1978 and tested in accordance with ASTM D3803-1989. The analysis results are to be verified as acceptable within 31 days after sample removal, or declare that train inoperable and take the actions specified in 3.7.B.1.c.

e. From and after the date that one train of the Standby Gas Treatment System is made or found to be inoperable for any reason, continued reactor operation, irradiated fuel handling, or new fuel handling over the spent fuel pool is permissible only during the succeeding seven days providing that within 2 hours all active components of the other standby gas treatment train are verified to be operable and the diesel generator associated with the operable train is operable.

If the system is not made fully operable within 7 days, reactor shutdown shall be initiated and the reactor shall be in cold shutdown within the next 36 hours and fuel handling operations shall be terminated within 2 hours.

Fuel handling operations in progress may be completed.

4.7 CONTAINMENT SYSTEMS (Cont.)

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System (Cont.)

each branch of the standby gas treatment system shall be demonstrated, with Specification 3.7.B.1.d satisfied.

5. Each train of the standby gas treatment system shall be operated for at least 15 minutes per month.

6. The tests and analysis of Specification 3.7.B.1.b.2 shall be performed after every 720 hours of system operation.

b. 1. In-place cold DOP testing shall be performed on the HEPA filters after each completed or partial replacement of the HEPA filter bank and after any structural maintenance on the HEPA filter system housing which could affect the HEPA filter bank bypass leakage.

2. Halogenated hydrocarbon testing shall be performed on the charcoal adsorber bank after each partial or complete replacement of the charcoal adsorber bank or after any structural maintenance on the charcoal adsorber housing which could affect the charcoal adsorber bank bypass leakage.

LIMITING CONDITIONS FOR OPERATION

3.7 CONTAINMENT SYSTEMS (Cont.)

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System (Cont.)

d. Fans shall operate within ± 10% of 4000 cfm.

replace with the following

, movement of recently irradiated fuel assemblies and operations with a potential for draining the reactor vessel (OPDRVs)

e. From and after the date that one train of the Standby Gas Treatment System is made or found to be inoperable for any reason during Refuel Outages, refueling operations are permissible only during the succeeding 7 days providing that within 2 hours all active components of the other train are verified to be operable and the diesel generator associated with the operable train is operable.

If the system is not made fully operable within 7 days,

i) place the operable train in operation immediately

or

recently

ii) suspend movement of irradiated fuel assemblies in secondary containment or new fuel handling over the spent fuel pool or core.

and initiate actions to suspend OPDRVs.

Any fuel assembly movement in progress may be completed.

SURVEILLANCE REQUIREMENTS

4.7 CONTAINMENT SYSTEMS (Cont.)

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System (Cont.)

LIMITING CONDITIONS FOR OPERATION

3.7 CONTAINMENT SYSTEMS (Cont.)

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System (Cont.)

2. Control Room High Efficiency Air Filtration System

   a. Except as specified in Specification 3.7.B.2.c or 3.7.B.2.e below, both trains of the Control Room High Efficiency Air Filtration System used for the processing of inlet air to the control room under accident conditions shall be operable when in the Run, Startup, and Hot Shutdown MODES, during movement of recently irradiated fuel assemblies in the secondary containment, ~~and during movement of new fuel~~ over the spent fuel pool, and during CORE ALTERATIONS, and during operations with a potential for draining the reactor vessel (OPDRVs),

      or

      the reactor shall be in cold shutdown within the next 36 hours.

   b. 1. The results of the in-place cold DOP tests on HEPA filters shall show ≥99% DOP removal. The results of the halogenated hydrocarbon tests on charcoal adsorber banks shall show ≥99.9% halogenated hydrocarbon removal when test results are extrapolated to the initiation of the test.

      2. The results of the laboratory carbon sample analysis shall show ≥97.5% methyl iodide removal at 70% R.H. and 86°F. The carbon sample shall be obtained in accordance with Regulatory Position C.6.b of Regulatory Guide 1.52, Revision 2, March 19~~78 and~~ tested in accordance with ASTM D3803-1989. The analysis results are to be verified as acceptable within 31 days after sample removal, or declare that train inoperable and take the actions specified in 3.7.B.2.c.

SURVEILLANCE REQUIREMENTS

4.7 CONTAINMENT SYSTEMS (Cont.)

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System (Cont.)

2. Control Room High Efficiency Air Filtration System

   a. At least once per operating cycle the pressure drop across each combined filter train shall be demonstrated to be less than 6 inches of water at 1000 cfm or the calculated equivalent.

   b. 1. The tests and analysis of Specifications 3.7.B.2.b shall be performed once per operating cycle or following painting, fire or chemical release in any ventilation zone communicating with the system while the system is operating.

      2. In-place cold DOP testing shall be performed after each complete or partial replacement of the HEPA filter bank or after any structural maintenance on the system housing which could affect the HEPA filter bank bypass leakage.

      3. Halogenated hydrocarbon testing shall be performed after each complete or partial replacement of the charcoal adsorber bank or after any structural maintenance on the system housing which could affect the charcoal adsorber bank bypass leakage.

      4. Each train shall be operated with the heaters in automatic for at least 15 minutes every month.

LIMITING CONDITIONS FOR OPERATION

3.7 CONTAINMENT SYSTEMS (Cont.)

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System (Cont.)

c. From and after the date that one train of the Control Room High Efficiency Air Filtration System is made or found to be inoperable for any reason, reactor operation, irradiated fuel handling, or new fuel handling over the spent fuel pool is permissible only during the succeeding 7 days providing that within 2 hours all active components of the other CRHEAF train are verified to be operable and the diesel generator associated with the operable train is operable. If the system is not made fully operable within 7 days, reactor shutdown shall be initiated and the reactor shall be in cold shutdown within the next 36 hours and fuel handling operations shall be terminated within 2 hours. Fuel handling operations in progress may be completed.

d. Fans shall operate within ± 10% of 1000 cfm.

e. From and after the date that one train of the Control Room High Efficiency Air Filtration System is made or found to be inoperable for any reason during Refuel Outages, refueling operations are permissible only during the succeeding 7 days providing that within 2 hours all active components of the other train are verified to be operable and the diesel generator associated with the operable train is operable.

replace with the following

, movement of recently irradiated fuel assemblies and operations with a potential for draining the reactor vessel (OPDRVs)

If the system is not made fully operable within 7 days,

SURVEILLANCE REQUIREMENTS

4.7 CONTAINMENT SYSTEMS (Cont.)

B. Standby Gas Treatment System and Control Room High Efficiency Air Filtration System (Cont.)

5. The test and analysis of Specification 3.7.B.2.b.2 shall be performed after every 720 hours of system operation.

c. At least once per operating cycle demonstrate that the inlet heaters on each train are operable and capable of an output of at least 14 kw.

d. Perform an instrument functional test on the humidistats controlling the heaters once per operating cycle.

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Amendment No. ~~42, 50, 51, 57, 112, 144, 151, 161,~~ ~~170~~

LIMITING CONDITIONS FOR OPERATION

3.7 CONTAINMENT SYSTEMS (Cont.)

i) perform surveillance 4.7.B.2.b.4 for the operable CRHEAF every 24 hours
or

ii) suspend movement of recently irradiated fuel assemblies in secondary containment or new fuel handling over the spent fuel pool or core and initiate action to suspend OPDRVs.

Any fuel assembly movement in progress may be completed.

C. Secondary Containment

1. Secondary containment shall be OPERABLE when in the Run, Startup and Hot Shutdown MODES, during movement of recently irradiated fuel assemblies in the secondary containment, and during movement of new fuel over the spent fuel pool, and during CORE ALTERATIONS, and during operations with a potential for draining the reactor vessel (OPDRVs).

2. a. With Secondary Containment inoperable when in the Run, Startup and Hot Shutdown MODES, restore Secondary Containment to OPERABLE status within 4 hours.

   b. Required Action and Completion Time of 2.a not met, be in Hot Shutdown in 12 hours AND Cold Shutdown within 36 hours.

   c. With Secondary Containment inoperable during movement of recently irradiated fuel assemblies in the secondary containment, and during movement of new fuel over the spent fuel pool, and during CORE ALTERATIONS, and during OPDRVs, immediately
      1. Suspend movement of recently irradiated fuel assemblies in the secondary containment.
         AND
      2. Suspend movement of new fuel over the spent fuel pool.
         AND
      3. Suspend CORE ALTERATIONS.
         AND
      2 ~~4~~. Initiate action~~s~~ to suspend OPDRVs.

SURVEILLANCE REQUIREMENTS

4.7 CONTAINMENT SYSTEMS (Cont.)

C. Secondary Containment

1. Each refueling outage prior to refueling, secondary containment capability shall be demonstrated to maintain 1/4 inch of water vacuum under calm wind (5 mph) conditions with a filter train flow rate of not more than 4000 cfm.

BASES:

3/4.7 CONTAINMENT SYSTEMS (Cont.)

Tests of impregnated charcoal identical to that used in the filters indicate that a shelf life of five years leads to only minor decreases in methyl iodide removal efficiency. Hence, the frequency of laboratory carbon sample analysis is adequate to demonstrate acceptability. Since adsorbers must be removed to perform this analysis this frequency also minimizes the system out of service time as a result of surveillance testing. In addition, although the halogenated hydrocarbon testing is basically a leak test, the adsorbers have charcoal of known efficiency and holding capacity for elemental iodine and/or methyl iodide, the testing also gives an indication of the relative efficiency of the installed system. The 31 day requirement for the ascertaining of test results ensures that the ability of the charcoal to perform its designed function is demonstrated and known in a timely manner.

The required Standby Gas Treatment System flow rate is that flow, less than or equal to 4000 CFM which is needed to maintain the Reactor Building at a 0.25 inch of water negative pressure under calm wind conditions. This capability is adequately demonstrated during Secondary Containment Leak Rate Testing performed pursuant to Technical Specification 4.7.C.1.c.

The test frequencies are adequate to detect equipment deterioration prior to significant defects, but the tests are not frequent enough to load the filters or adsorbers, thus reducing their reserve capacity too quickly. The filter testing is performed pursuant to appropriate procedures reviewed and approved by the Operations Review Committee pursuant to Section 6 of these Technical Specifications. The in-place testing of charcoal filters is performed by injecting a halogenated hydrocarbon into the system upstream of the charcoal adsorbers. Measurements of the concentration upstream and downstream are made. The ratio of the inlet and outlet concentrations gives an overall indication of the leak tightness of the system. A similar procedure substituting dioctyl phthalate for halogenated hydrocarbon is used to test the HEPA filters.

Pressure drop tests across filter and adsorber banks are performed to detect plugging or leak paths though the filter or adsorber media. Considering the relatively short times the fans will be run for test purposes, plugging is unlikely and the test interval of once per operating cycle is reasonable.

System drains and housing gasket doors are designed such that any leakage would be inleakage from the Standby Gas Treatment System Room. This ensures that there will be no bypass of process air around the filters or adsorbers.

Only one of the two Standby Gas Treatment Systems (SBGTS) is needed to maintain the secondary containment at a 0.25 inch of water negative pressure upon containment isolation. If one system is made or found to be inoperable, there is no immediate threat to the containment system performance and reactor operation or refueling activities may continue while repairs are being made. In the event one SBGTS is inoperable, the redundant system's active components will be verified to be operable within 2 hours. This substantiates the availability of the operable system and justifies continued reactor or refueling operations.

During refueling outages, if the inoperable train is not restored to operable status within the required completion time, the operable train should immediately be placed in operation. This action ensures that the remaining train is operable, that no failures that could prevent automatic actuation have occurred, and that any other failure would be readily detected. An alternative is to suspend fuel movement, thus, placing the plant in a condition that minimizes risk.

INSERT A

If both trains of SBGTS are inoperable, the plant is brought to a condition where the SBGTS is not required.

INSERT A

B.2 Control Room High Efficiency Air Filtration System

The Control Room High Efficiency Air Filtration System is designed to filter intake air for the control room atmosphere during conditions when normal intake air may be contaminated. Following manual initiation, the Control Room High Efficiency Air Filtration System is designed to position dampers and start fans which divert the normal air flow through charcoal adsorbers before it reaches the control room.

High Efficiency Particulate Air (HEPA) filters are installed before the charcoal adsorbers to prevent clogging of the iodine adsorbers. The charcoal adsorbers are installed to reduce the potential intake of radioiodine to the control room. A second bank of HEPA filters is installed downstream of the charcoal filter.

The in-place test results should indicate a system leak tightness of less than 0.1% bypass leakage for the charcoal adsorbers and a HEPA efficiency of at least 99% removal of cold DOP particulates. The laboratory carbon sample test results should indicate a methyl iodide removal efficiency of at least 97.5% for expected accident conditions. Tests of impregnated charcoal identical to that used in the filters indicate that a shelf life of five years leads to only minor decreases in methyl iodine removal efficiency. Hence, the frequency of laboratory carbon sample analysis is adequate to demonstrate acceptability. Since adsorbers must be removed to perform this analysis, this frequency also minimizes the system out of service time as a result of surveillance testing. In addition, although the halogenated hydrocarbon testing is basically a leak test, the adsorbers have charcoal of known efficiency and holding capacity for elemental iodine and/or methyl iodide, the testing also gives an indication of the relative efficiency of the installed system. The 31 day requirement for the ascertaining of test results ensures that the ability of the charcoal to perform its designed function is demonstrated and known in a timely manner.

Determination of the system pressure drop once per operating cycle provides indication that the HEPA filters and charcoal adsorbers are not clogged by excessive amounts of foreign matter and that no bypass routes through the filters or adsorbers had developed. Considering the relatively short times the systems will be operated for test purposes, plugging is unlikely and the test interval of once per operating cycle is reasonable.

INSERT "A" TO PAGE B3/4.7-10

As discussed in Bases Section B3/4.7.C "Secondary Containment", SGTS is not required to be operable during movement of irradiated fuel assemblies that have been allowed to decay for the minimum specified decay period i.e., no longer "recently irradiated".

During movement of recently irradiated fuel, if one train of SGTS is made or found to be inoperable and the inoperable train is not restored to operable status within the required completion time, the operable train should immediately be placed in operation. This action ensures that the remaining train is operable, that no failures that could prevent automatic actuation have occurred, and that any other failure would be readily detected. An alternative is to suspend movement of recently irradiated fuel, thus, placing the plant in a condition that minimizes risk. If both trains of SBGTS are inoperable, the plant is brought to a condition where the SBGTS is not required.

INSERT "B" TO PAGE B3/4.7-12

As discussed in Bases Section B3/4.7.C "Secondary Containment", CRHEAFS is not required to be operable during movement of irradiated fuel assemblies that have been allowed to decay for the minimum specified decay period i.e., no longer "recently irradiated".

B.2 Control Room High Efficiency Air Filtration System (Cont.)

The test frequencies are adequate to detect equipment deterioration prior to significant defects, but the tests are not frequent enough to load the filters or adsorbers, thus reducing their reserve capacity too quickly. The filter testing is performed pursuant to appropriate procedures reviewed and approved by the Operations Review Committee pursuant to Section 6 of these Technical Specifications. The in-place testing of charcoal filters is performed by injecting a halogenated hydrocarbon into the system upstream of the charcoal adsorbers. Measurements of the concentration upstream and downstream are made. The ratio of the inlet and outlet concentrations gives an overall indication of the leak tightness of the system. A similar procedure substituting dioctyl phthalate for halogenated hydrocarbon is used to test the HEPA filters.

Air flow through the filters and charcoal adsorbers for 15 minutes each month assures operability of the system. Since the system heaters are automatically controlled, the air flowing through the filters and adsorbers will be ≤70% relative humidity and will have the desired drying effect.

e

If one train of the system is made or found to be inoperable, there is no immediate threat to the control room, and reactor operation or fuel handling may continue for a limited period of time while repairs are being made. In the event one CRHEAF train is inoperable, the redundant system's active components will be verified to be operable within 2 hours. During refueling outages, if the inoperable train is not restored to operable status within the required completion time, refueling operations may continue provided the operable CRHEAF train is placed in the pressurization mode daily. This action ensures that the remaining train is operable, that no failures that would prevent actuation will occur, and that any active failure will be readily detected. An alternative is to suspend activities that present a potential for releasing radioactivity that might require isolation of the control room. If both trains of the CRHEAF system are inoperable, the reactor will be brought to a condition where the Control Room High Efficiency Air Filtration System is not required.

→ INSERT B

C. Secondary Containment

INSERT C

~~The secondary containment is designed to minimize any ground level release of radioactive materials which might result from a serious accident. The reactor building provides secondary containment during reactor operation, when the drywell is sealed and in service; the reactor building provides primary containment when the reactor is shutdown and the drywell is open, as during refueling. Because the secondary containment is an integral part of the complete containment system, secondary containment is required at all times that primary containment is required as well as during refueling.~~

~~There are two principal accidents for which credit is taken for secondary containment operability. These are a loss of coolant accident (LOCA) and a fuel handling accident inside [secondary] containment. The secondary containment performs no active function in response to each of these limiting events; however, its leak tightness is required to ensure that the release of radioactive materials from the primary containment is restricted to those leakage paths and associated leakage rates assumed in the accident analysis and that fission products entrapped within the secondary containment structure will be treated by the SGT System prior to discharge to the environment.~~

~~An operable secondary containment provides a control volume into which fission products that bypass or leak from primary containment, or are released from the reactor coolant pressure boundary components located in secondary containment can be diluted and processed prior to release to the environment. For the secondary containment to be considered operable, it must have adequate leak tightness to ensure that the required vacuum can be established and maintained.~~

~~If secondary containment is inoperable (when required to be operable), it must be restored to operable status within 4 hours. The 4 hour completion time provides a period of time to correct the problem that is commensurate with the importance of maintaining secondary containment during Run, Startup, and Hot Shutdown modes. This time period also ensures that the probability of an accident (requiring secondary containment operability) occurring during periods where secondary containment is inoperable is minimal.~~

~~If secondary containment cannot be restored to operable status within the required completion time, the plant must be brought to a mode in which the LCO does not apply. To achieve this status, the plant must be brought to at least Hot Shutdown within 12 hours and to Cold Shutdown within 36 hours. The allowed completion times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.~~

~~Movement of irradiated fuel assemblies in the secondary containment, movement of new fuel over the spent fuel pool, core alterations, and OPDRVs can be postulated to cause fission product release to the secondary containment. In such cases, the secondary containment is the only barrier to release of fission products to the environment. Core alterations, movement of irradiated fuel assemblies, and movement of new fuel over the spent fuel pool must be immediately suspended if the secondary containment is inoperable.~~

~~Suspension of these activities shall not preclude completing an action that involves moving a component to a safe position. Also, action must be immediately initiated to suspend OPDRVs to minimize the probability of a vessel draindown and subsequent potential for fission product release. Actions must continue until OPDRVs are suspended.~~

Initiating reactor building isolation and operation of the standby gas treatment system to maintain at least a 1/4 inch of water negative pressure within the secondary containment provides an adequate test of the operation of the reactor building isolation valves, leak tightness of the reactor building and performance of the standby gas treatment system. Functionally testing the initiating sensors and associated trip channels demonstrates the capability for automatic actuation. Performing these tests prior to refueling will demonstrate secondary containment capability prior to the time the primary containment is opened for refueling. Periodic testing gives sufficient confidence of reactor building integrity and standby gas treatment system performance capability.

INSERT "C" TO PAGE B3/4.7-13

The secondary containment is designed to minimize any ground level release of radioactive materials that might result from a serious accident. The reactor building provides secondary containment during reactor operation, when the drywell is sealed and in service; the reactor building provides primary containment during periods when the reactor is shutdown, the drywell is open, and activities are ongoing that require secondary containment to be operable. Because the secondary containment is an integral part of the complete containment system, secondary containment is required at all times that primary containment is required as well as during movement of "recently irradiated" fuel and during operations with the potential to drain the reactor vessel (OPDRV).

There are two principal accidents for which credit is taken for secondary containment operability. These are a loss of coolant accident (LOCA) although not specifically evaluated for alternate source term methodology and a fuel handling accident involving "recently irradiated" fuel. The secondary containment performs no active function in response to each of these limiting events; however, its leak tightness is required to ensure that the release of radioactive materials from primary containment is restricted to those leakage paths and associated leakage rates assumed in the accident analysis and that fission products entrapped within the secondary containment structure will be treated by the Standby Gas Treatment System (SGTS) prior to discharge to the environment.

In addition to these limiting accidents, OPDRVs can be postulated to cause a fission product release. During movement of recently irradiated fuel and OPDRVs, secondary containment would be the only barrier to a release to the environment. Therefore, movement of recently irradiated fuel and OPDRVs must be immediately suspended if the secondary containment is inoperable. Suspension of these activities shall not preclude completing an action that involves moving a component to a safe position. Also, action must be immediately initiated to suspend OPDRVs to minimize the probability of a vessel drain down and subsequent potential for fission product release. Actions must continue until OPDRVs are suspended.

An operable secondary containment provides a control volume into which fission products that bypass or leak from primary containment, or are released from the reactor coolant pressure boundary components located in secondary containment can be diluted and processed prior to release to the environment. For the secondary containment to be considered operable, it must have adequate leak tightness to ensure that the required vacuum can be established and maintained.

If secondary containment is inoperable (when required to be operable), it must be restored to operable status within 4 hours. The 4-hour completion time provides a period of time to correct the problem that is commensurate with importance of maintaining secondary containment during Run, Startup, and Hot Shutdown modes. This time period also ensures that the probability of an accident (requiring secondary containment operability) occurring during periods where secondary containment is inoperable is minimal.

If secondary containment cannot be restored to operable status within the required completion time, the plant must be brought to a mode in which the LCO does not apply. To achieve this status during power operation, the plant must be brought to at least Hot Shutdown within 12 hours and to Cold Shutdown within 36 hours. The allowed completion times are reasonable, based on operating experience, to reach the required plant conditions from full power condition in an orderly manner and without challenging plant systems.

The Fuel Handling Accident (FHA) analysis is based on 10 CFR 50.67 and R.G. 1.183 Alternate Source Term Methodology. This parametric analysis concluded that the calculated TEDE values to the control room occupants, the exclusion area boundary, and the low population zone are well below the allowable TEDE limits established in 10 CFR 50.67 without crediting Secondary Containment, SGTS and CRHEAFS as long as a the fuel is allowed to decay for at least 24 hours following reactor shutdown.

As a result, "Recently irradiated" fuel is defined as fuel that has occupied part of a critical reactor core within the previous 24 hours, i.e. reactor fuel that has decayed less than 24 hours following reactor shutdown. Each fuel cycle, prior to the refueling outage, the decay period that must elapse prior to movement of irradiated fuel in the core will be re-evaluated to ensure the appropriate, minimum decay period is enforced to maintain the validity of the FHA dose consequence analysis.

Therefore, SGTS, CRHEAFS and Secondary Containment are not required to be operable during movement of decayed irradiated fuel that is no longer is considered "recently irradiated". Conversely, Secondary

Attachment 5 to 2.04.115

Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Plant
Proposed Amendment to the Technical Specifications

Summary of Commitments

Commitment ID	Description	Due Date
1.	Entergy will revise the Pilgrim guidelines for assessing systems removed from service during the handling of non-recently irradiated fuel assemblies or core alterations to implement the provisions of Section 11.3.6.5 of NUMARC 93-01, Revision 3.	Completed prior to the implementation of this license amendment.
2.	Revise Pilgrim UFSAR to reflect revised fuel handling analyses and alternate source term.	Completed in accordance with next scheduled FSAR update after approval of this application.

(1 page)

Attachment 6 to 2.04.115

Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Plant
Proposed Amendment to the Technical Specifications

Response to NRC Request for Additional Information

(7 pages)

Response to NRC Request for Additional Information

NRC Question 1:

The April 14, 2004 submittal includes various radiological consequences analyses for the fuel handling accident (FHA) assuming that the damaged fuel has decayed 24 hours and assuming credit for filtration by the standby gas treatment system (SGTS) and/or the control room high efficiency air filtration system (CRHEAFS).

a. For the analyses that credit CRHEAFS operation, give the basis for the control room envelope unfiltered inleakage assumption of 500 cfm. Has testing been performed to verify this assumption?

b. For the analyses that credit SGTS operation, what is the design SGTS flow rate that would be expected for the design basis FHA? This is not the modeling assumption that allows for the release to the environment in 2 hours, but the actual flow rate.

Response:

The revised calculation for the radiological consequences of a fuel handling accident no longer credits CRHEAFS or SGTS.

NRC Question 2:

The April 14, 2004 submittal includes various FHA analyses to show that after the fuel has decayed 48 hours, no filtration credit for the SGTS or CRHEAFS is necessary to meet the regulatory dose acceptance criteria. Is movement of the fuel expected to occur prior to 48 hours after the reactor has shut down? Are there any technical specifications or administrative controls at Pilgrim that apply to when fuel movement is allowed post shutdown?

Response:

The revised FHA demonstrates that after 24 hours of decay, SGTS and CRHEAFS filtrations are not necessary to comply with the regulatory acceptance criteria. It is not considered credible to move fuel with less than 24 hours of decay. This assumption will be included in the revised FSAR discussion of this analysis.

NRC Question 3:

On page 26 of Attachment 1 of the April 14, 2004 submittal, Pilgrim commits to implement the provisions of Section 11.3.6.5 of NUMARC 93-01, "Industry Guidelines for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," to address capabilities to promptly close secondary containment, as is consistent with TSTF-51. NUMARC 93-01 states in part that "these prompt methods need not completely block the penetrations nor be capable of resisting pressure, but are to enable the ventilation systems to draw from the postulated FHA such that it can be treated and monitored."

a. Please describe the prompt methods including time required to close and the degree of closure that will be achieved.

b. How much of an open area to the environment would be permitted?

c. Also describe the ventilation systems that would be used to draw the release from the postulated FHA. Specifically, are the ventilation systems engineered safety feature systems, do they have carbon adsorber filters and high-efficiency particulate air filters, are they tested in accordance with Regulatory Guide (RG) 1.52 or other standards, and do they have sufficient drawing capacity to assure that air flow is from environment to the containment?

d. Would there be a test to determine that all air flow was into the containment in the event that the Pilgrim procedure allows partial closure?

e. Other licensees have provided information on how they intend to meet the recommendations and made specific notation of the requirement in the Technical Specifications to close the containment in the event of an FHA. Does Pilgrim have the capability to make a similar commitment?

Response:

10 CFR 50.65(a)(4) requires Pilgrim to assess and manage changes in risk that result from taking risk-significant systems out-of-service or during certain maintenance activities. The NRC staff, in Regulatory Guide 1.182 states that the methods detailed in Section 11 of NUMARC 93-01 are acceptable for complying with the requirements of 10 CFR 50.65(a)(4). Pilgrim has implemented a Configuration Risk Management Program (Technical Specification 5.5.7) for assessing changes in risk that could result from taking risk-significant systems out-of-service during maintenance activities. This program, which was reviewed and approved by the NRC for Operating License Amendment 187, follows the requirements of 10 CFR 50.65(a)(4) and Section 11 of NUMARC 93-01. Pilgrim has implemented this program through plant procedures 1.5.22, "Risk Assessment Process" and 8.M.1-45, "Outage Shutdown Risk Assessment".

Accordingly, Pilgrim develops risk profile associated with the plant configuration and implements administrative controls prior to removing risk-significant systems or equipment for service using procedure 1.5.22. This qualitative and quantitative process is followed during refueling outages to determine shutdown risk profile to ensure plant configuration remains in the least risk-significant condition. The scope and type of administrative controls are developed based upon the type of risk-significant system being removed from service and system alignment requirements for available systems to remain in the least risk-significant condition.

The outage shutdown risk assessment procedure (8.M.1-45) establishes the methodology for conducting a planned outage safety review to reduce the likelihood and/or consequences of an adverse event during planned outage. This methodology follows the guidance of NUMARC 91-06, "Guidelines for Industry Actions to Assess Shutdown Management". In accordance with this procedure, Pilgrim develops a contingency plan – an approved plan of compensatory actions – to maintain and restore defense-in-depth system availability when system availability drops below the level planned for the outage and to minimize the likelihood of loss of a key safety function during high risk evolution. This contingency plan addresses the plant-specific configuration taking into account the planned system maintenance and refueling operational activities, such that, if a fuel handling accident were to take place, system alignments, administrative controls, and compensatory measures will be employed to minimize the release of radioactivity to the environment.

Response to a, b, and c:

After the 24 hours decay time, Pilgrim plans to allow the reactor building truck lock doors to be opened to the environment to facilitate ingress and egress, and transfer of heavy equipment when necessary. The truck lock door area is the largest opening in the secondary containment, which is approximately 400 sq. ft. (20ft x20 ft) and has two 20x20 ft inside and outside doors separated by about 125 ft distance and are easily closed. The truck lock opening doors control the ingress and egress to the security vital area and radiological control area (RCA). Normally, at any time during refueling outage only one door will be opened at any time. Both doors will be kept open for a very short time in order to facilitate the transit of equipment. During refueling outage, the truck lock door area is continually manned or monitored by a member of the security force since it potentially allows access to vital area and the RCA. In addition to the truck lock opening, Pilgrim may cut out openings or penetrations into the secondary containment walls to facilitate large equipment removal and installation; however, such openings or penetrations would not be larger than 20X20 ft, and would be cut out only on an as need basis and will be closed after their use.

The area radiation monitors on the refueling floor provide indication for prompt actions in the event of a fuel handling accident. In the event of a fuel handling accident, the radiation monitor high range set point initiates the secondary containment isolation through the reactor building isolation and control system (RBICS). The RBICS serves to trip the reactor building supply and exhaust fans, isolate the normal ventilation system, and provide for SGTS starting signal, as described in FSAR Section 5.3. Following initiation, the reactor building ventilation isolation dampers close within a specified time (3 sec) to prevent release of radioactive material from the secondary containment. The refueling floor exhaust isolation dampers must close in 3 sec to isolate the most direct path outside the secondary containment. The RBICS also automatically trips the reactor building supply and exhaust fans and starts the SGTS. The normal design flow rate in the reactor building operating (refueling) floor exhaust duct is 40,000 cfm. During shutdown the flow rate is increased to approximately 50,000 cfm, at which time it takes more than 3 sec for the fission products released in any postulated fuel handling accident to travel from the operating (refueling) floor ventilation exhaust radiation monitors to the isolation dampers. Thus, no direct release of fission products to the environment (by passing the SGTS filtration process and the elevated release point provided by the main stack) is possible. Prompt action initiated by the RBICS assures that the radioactive flume remains on the refueling floor and exhausts through the SGTS filtration system when this equipment is available.

Even though SGTS and CRHEAFS are not required to be operable to comply with the NRC acceptance criteria in the event of a fuel handling accident after 24 hours of decay, to minimize the dose consequences from release of radioactivity, Pilgrim will follow these steps:

1. Promptly close the truck lock doors and any other cutout openings in the secondary containment, and secure the secondary containment atmosphere.

2. Align the available SGTS filtration system and place it in operation. Normally only one train will be removed for maintenance and the other train will be available.

3. If both SGTS trains are out of service (a worst-case scenario), Reactor Building Heating and Ventilation System (RBHVS) may be manually started and placed in operation to vent the building unless it isolated on a high radiation signal. Until the RBHVS is placed in operation, the radioactive plume would remain on the refueling floor since the truck lock doors and cutout openings in the secondary containment would be closed and the refueling floor atmosphere would be at the outside environment pressure and there would be no significant air movement in or out of the building. As described in FSAR, Section 10.9.3.3, the RBHVS is divided into three major ventilation zones. The operating floor ventilation encompasses the refueling floor atmosphere and has sufficient drawing capacity (2 fans) to assure that airflow from environment to the containment takes place and the refueling floor atmosphere exhausts through the unfiltered reactor building vent. The RBHVS does not have charcoal adsorber filtration system. FHA

analyses demonstrate that the dose consequences from the unfiltered plume are below the regulatory acceptance limits to the occupants in the control room, LPZ, and EAB after 24 hours of decay time.

Response to d:

There would be no test to determine the airflow to the containment. The design of the reactor building operating floor ventilation encompasses the refueling floor atmosphere and has sufficient drawing capacity (2 fans) to assure that airflow from environment to the containment takes place, as described in FSAR Section 10.9.3.3.

Response to e:

Pilgrim has committed to implement the provisions of Section 11.3.6.5 of NUMARC 93-01 (See Attachment 6) to address capabilities to promptly close secondary containment, but does not make any new commitments or notations to the Technical Specifications, as they are not needed. The current and the proposed Technical Specifications requires Pilgrim to maintain the integrity of the secondary containment during the 24 hours following subcriticality and follows the prompt response actions as discussed above in the event of a fuel handling accident after 24 hours of achieving subcriticality.

NRC Question 4:

Confirm that, overall, the meteorological data used in the assessment are of high quality, suitable for use in the assessment of atmospheric dispersion to which it was applied, and provide an electronic copy of the hourly meteorological measurements on the docket.* Does the collection program meet RG 1.23, "Onsite Meteorological Programs," guidelines? During the period of data collection, was the tower base area on a natural surface (e.g., short natural vegetation) and was the tower free from obstructions (e.g., trees, structures, terrain) and micro-scale influences to ensure that the data were representative of the overall site area? In the case of possible obstructions, were trees, structures, etc., at least 10 times their height away from the meteorological tower? Were instruments and systems maintained within specifications? What types of quality assurance audits were performed on the meteorological measurement systems to ensure that data were of high quality and to identify any problems and questionable data and correct problems in a timely manner? What additional checks and at what frequency were the checks performed on data following collection, prior to archival, and following formatting for input into the analysis of atmospheric dispersion (e.g., using ARCON96)? If deviations occurred, describe such deviations and why the data are still deemed to be adequate. Were the data compared with other site historical or regional data? If so, what were the findings?

Response:

The original submittal used data from both the 220-ft meteorological tower (Tower A) and the 160-ft meteorological tower (Tower B). The Tower B does not meet the meteorological siting criteria recommended by R.G. 1.23. The revised submittal uses the meteorological data only from the Tower A, which meets R.G. 1.23 meteorological siting criteria and effectively resolves the issues raised regarding the quality of the meteorological data.

The 220 ft Tower A is located approximately 430 meters WNW of the Reactor Building, on a vegetated hillside approximately 275 meters from the shoreline. The base of the tower is kept in a state of natural vegetation, with periodic brush clearing to maintain vegetation height at less than the 10X height criterion. During the time period in question, routine sensor replacement was occurring on a quarterly (3-month) interval, using sensors calibrated at the vendor facility traceable to NIST standards. Qualitative checks (wind direction alignment to cardinal sectors, ice bath tests for temperature sensors, etc.) were performed during these quarterly calibration/equipment exchanges. Pilgrim also performed daily quality screening of data to look for grossly anomalous or missing data, as well as weekly zero and span calibration checks of equipment. Monthly data sets were edited to indicate invalid data flags for calibrations and known sensor malfunctions. These monthly data files were then submitted to a contractor for processing of joint frequency distribution and X/Q calculations. As part of this contracted service, data were screened using NUREG-0917 quality screening criteria. The data for the five-year period 1996-2000 used in the ARCON and AEOLUS runs were re-screened using NUREG-0917 criteria and found to be suitable for use. Overall data recovery for the six-year period was approximately 94%, with the lowest recovery during any individual year being 90.8%. Joint frequency distributions (JFD) calculated from the 1996-2001 period were compared to historical JFD data for the years 1992 and 1993 and found to be comparable.

Although six years of meteorological data were evaluated for suitability, only the five-year data set from 1996 through 2000 was used in calculations of X/Q values.

NRC Question 5:

Staff review indicates some apparent anomalies in the 1996 through 2000 meteorological data as submitted. The following are provided as examples. Therefore, please check the data and confirm that the data as provided are of high quality or amend the file(s) as appropriate. If an amendment is needed, provide a copy of the revised file(s), the basis for acceptability of any residual departures from typical conditions and RG 1.23, "Onsite Meteorological Programs," and the revised χ/Q values, if appropriate.

a) Why were there several periods of relatively long data outage (e.g., more than a week)? Have changes been implemented to address conditions causing such outages?

b) With regard to general data formatting, how are invalid atmospheric stability data identified? Is the wind data for Pilgrim A 1999 transposed with upper level values in the lower level columns and vise versa?

c) Staff acknowledges Pilgrim A data were measured at the 67.1 and 10.1 meter levels on one tower and Pilgrim B data were measured at the 48.8 and 10.1 meter levels on a second tower. In the following questions, the tower used to measure Pilgrim A data will be called Tower A and the tower used to measure Pilgrim B data will be called Tower B. Where are the two towers located? Does the difference in location result in differences in the measurements (e.g., due to terrain) and, if so, under what conditions are the differences likely to occur? What is the resultant impact on the X/Q values?

d) With regard to atmospheric stability, there appears to be a higher reported occurrence of stability class A on Tower A, between the 67.1 and 10.1 meter levels (about 25%), as compared to measurements on Tower B, between the 48.8 and 10.1 meter levels (14%). Generally, for measurements on a single tower, one would expect a higher occurrence of class A conditions between the narrower measurement interval than between the wider measurement interval. Similarly, neutral conditions were reported to occur slightly more frequently on Tower B, over the narrower measurement interval, than on Tower A, over the wider measurement interval. Further, the 25% average for the Pilgrim A data is slightly higher than the averages for classes D and E. Why does class A occur so frequently?

Regarding the Pilgrim B data, there appears to be considerable year-to-year variability in a couple of cases in the occurrence of classes A and G. To what is this attributed?

In both the Pilgrim A and B files, multiple lengthy occurrences of both class A and class G are reported. The longest occurrence of class A is approximately 374 hours and class G is 2489 hours. Is some of this data invalid? Also, in general, there was a relatively large number of occurrences of unstable conditions reported at night and stable conditions during the day. Since unstable conditions typically tend to occur during the daytime and stable conditions at night at many sites, what factors contributed to the occurrence of unstable conditions at night and stable conditions during the day at the Pilgrim?

e) The reported Pilgrim B wind speeds at the 10.1 meter level appear to be somewhat higher than the 10.1 meter Pilgrim A data. To what is that attributed?

Response to 5.a, b. c. d, and e.

As previously stated, the revised calculations use Tower A meteorological data, which meets the siting criteria recommended in R.G. 1.23. The revised calculations do not use Tower B data, as such the above-identified discrepancies and the apparent anomalies in the meteorological data are resolved by using the Tower A data. The annual data recoveries for Tower A for the six-year period 1996-2001 ranged from 90.8% to 97.1%, and averaged 94.3% for the entire period. In most cases involving Tower A, failed meteorological sensors were replaced within one to two days of the problem being identified. If the specific time of failure could not be identified, data immediately prior to failure identification were evaluated, and were flagged invalid if the data were suspect. In the data processed for the re-submittal, Class A stability occurred 13% of the time, comparable to frequencies for this class in years preceding and following the six-year period in question. Using the same six-year data set, Class D occurred 30% of the time, while Class E occurred 35% of the time. The enclosed disk provides the Tower A meteorological data used in the revised calculations. Although six years of meteorological data was evaluated for suitability, only five-year data set from 1996 through 2000 was used in calculations of X/Q values. In all data sets all invalid data are flagged with a value of "9999".

NRC Question 6:

Provide a figure or figures showing structures, assumed paths of air flow, dimensions, heights and distances used as input in estimating the postulated transport of effluent from each of the release locations to the receptors. Are all directional inputs defined in terms of true north? If the figures are drawn in relation to plant or magnetic north, what is the relationship to true north, assuming that the meteorological measurements are based upon true north?

Response:

The enclosed Pilgrim site plan provides the relative locations of the buildings and stack.

NRC Question 7:

If more than one release to the environment/transport scenario could occur (e.g., loss of offsite power and non-loss of site power, single failure), were comparative X/Q calculations made to ensure consideration of the limiting dose?

Response:

Reactor building vent release without filtration is the most is the limiting scenario. The potential releases through the reactor building truck lock door lead to lower radiological impact. Comparative X/Q values were used in each case, as shown in the revised calculations.

NRC Question 8:

Was RG 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," guidance used when making the X/Q estimates for the stack release to the control room air intake? Were the ARCON96 X/Q values always the more limiting case?

Response:

R.G. 1.194 is used for the X/Q estimates for the stack release to the control room intake.

NRC Question 9:

The stack effluent vertical velocity is input into ARCON96 as 4.06 meters per second and stack flow as 1.7 cubic meters per second. Can this flow be maintained during the course of an accident (e.g., as addressed by technical specifications) even if a single failure or loss of offsite power occurs?

Response:

The revised calculation no longer credits SGTS, thus this question is not applicable.

NRC Question 10:

Did dose estimates for the exclusion area boundary and low population zone use previously approved X/Q values? If so, provide a reference citation. If new X/Q values were calculated, provide a description of the methodology, inputs and assumptions used. If the PAVAN (NUREG/CR-2858, "PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations") computer code was used, provide a copy of the PAVAN input files.

Response:

New X/Q values were calculated for the revised submittal. A copy of the calculation is attached, which provides the methodology, inputs, and assumptions used.

Encl: Pilgrim Site Plan Drawings, C-1, Rev E2; C-2, Rev. E9; and A-105, Rev 2

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